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IRRIGATION IN YAKIMA COUNTY, WASHINGTON.

By A. B. WYCKOFF.

THE recent annual report of the Secretary of the Interior contains a strong recommendation to Congress that provision should be made for reclaiming the vast stretches of arid but naturally fertile land which occur in the Western States. We learn from the report that out of a total of 500,000,000 acres of arid land fully 100,000,000 acres might be reclaimed by systematic irrigation.

It is difficult for the average reader to comprehend the wonderful transformation which is wrought on the barren face of the desert by the irrigating ditch; and any written or illustrated description can give at best but a general and inadequate impression. The transformation must be seen to be understood, and the eye must take in the startling contrast presented by the dull, monotonous stretches of original desert and the dazzling beauty of the irrigated lands. The one abuts sharply upon the other, the everlasting sand, sage brush and bunch grass, dusty, waterless, and barren, lying side by side with the richest and greenest of pastures and orchards that bend low beneath their heavy burden of fruit.

IRRIGATION CANAL, YAKIMA VALLEY, WASHINGTON.

There is no section of the western country where the results of irrigation have been more uniformly excellent than in eastern Washington, and particularly in that section of it that is watered by the Yakima River. Yakima County lies between latitudes 46° and 47° N. and longitudes 119° and 122° W. It contains 5,580 square miles, or 3,571,200 acres, and is somewhat larger than the State of Connecticut. The Columbia River borders the county on the north and east for over eighty miles, while the summit of the Cascade Mountains forms its western boundary. The Yakima River has its source in several lakes near the summit of the Cascades, and flows diagonally through the county for over one hundred miles, cutting through several basaltic ranges of high hills and the large inclosed valleys. A number of rivers flow into the Yakima from the westward, and being fed by the springs and glaciers of the Cascades, retain a large proportion of their volume during the hot months. The Cascade Mountains, trending north and south, divide the State of Washington into two nearly square parts. The westerly winds from the warm Japan stream of the Pacific are laden with an excessive amount of moisture, which during several months of the year is deposited as snow among the dense forests of the summit of the Cascades. This is the great reservoir of the many rivers of Washington. The several branching ranges of high hills to the eastward inclose large valleys, which are heavily wooded near the mountains, but gradually merge into sage brush and aridity. The perennial streams which flow through them furnish the ample means for their reclamation.

The total area of irrigable lands which can be reclaimed at reasonable cost is about 650,000 acres. As the Yakima River and all its tributaries have very rapid falls, and are not sunk in deep channels, the construction of irrigating canals does not meet with any great engineering difficulties, and is, therefore, a matter of comparatively small expense.

The Yakima Valley enjoys the unique advantage of being the only irrigable locality in the country which has an ample and unfailing supply of water throughout the crop season. In fact, the superabundance of this supply has, thus far, been rather a drawback to obtaining the best results, owing to the tendency of inexperienced farmers to flood their crops with too much water.

The figures of the United States Geological Survey show that the average discharge of the Yakima River is never less than 2,248 cubic feet per second, this being the amount in September; in December it is 4,412 cubic feet; in February, 5,111 cubic feet; in April, 11,460 cubic feet; in May, 21,500 cubic feet (the maximum); in June, 17,930 cubic feet; and in July, 5,090 cubic feet.

The following, from the same source, compares the October discharge of the several principal rivers of the United States whose waters are used for irrigation: Cubic feet per second—Yakima, 2,692; W. Gallatin, 576; Yellowstone, 1,630; Missouri, 3,511; Arkansas, 511; Rio Grande, 263; Bear, 737.

From a table in the United States Geological Survey of 1891-92, it is seen that the first cost of securing water and the annual expense of maintaining ditches is less in this State than any other, while the percentage of value of crops, as compared with value of land, is much greater.

In the central part of the country, and lying east of the Yakima River, is the Moxee Valley, some twenty-five miles long and averaging five in width. Several thousand acres of fine land in the upper portion of the valley could not be reclaimed by gravity irrigation, and, in 1891, notwithstanding the unfavorable prognostications of geologists, an artesian well was started which struck a strong flow of water at a depth of 314 feet. Several other wells have since been put down, varying in depth from 300 to 1,000 feet. All the wells show somewhat similar characteristics. They are all through John Day beds (gravel, sand, clay, shale, sandstone), interstratified with thin sheets of Columbia lava, except the higher wells, which encountered no basalt. The temperature of the water varies from 65° F. in the shallowest to 75° F. in the deepest well, but the fact that no flowing water can be obtained at a greater surface elevation than 1,190 feet above sea level would lead to the conclusion that the sources are virtually the same. It is probable that this artesian basin is an accidental one, fed through fissures in the Columbia lava, and the water has taken the high temperature of the lava through which it has passed.

The soil in Yakima County is of exceeding richness. It consists mostly of sedimentary materials deposited at the bottoms of the lakes which covered these valleys for centuries. It is largely disintegrated basaltic rocks, and contains all the necessary chemical elements for great productiveness. While it is porous and absorbs water, yet it has good consistency, is easily worked and does not bake like clayey lands. Artificial fertilizers will probably never be necessary.

The following analysis, made by the Department of Chemistry of the State Agricultural College, of the soil of Yakima County, shows that it is especially rich in lime, potash and phosphoric acid, the three constituents most essential to plant life.

Insoluble silica	71·670
Combined silica	5·110
Soluble silica	0·180
Potash	1·070
Soda	0·350
Lime	2·000
Magnesia	1·340
Peroxide of iron	6·880
Alumina	7·910
Phosphoric acid	0·130
Sulphuric acid	0·090
Chlorine	trace.
Water, at 120° C.	1·510
Volatile and organic matter	1·310

There are many irrigation enterprises in the county, and about 150,000 acres are under ditch, one-half of which are being cultivated. The financial depression of the last four years has militated against the settlement of the arid regions, and yet the cultivated area and population of the valley have nearly doubled during that time. The following table shows the size and cost of ditches and the amount of land reclaimed and under cultivation:

YAKIMA VALLEY, TWO MILES SOUTHWEST OF NORTH YAKIMA.

Canal.	Length. Miles.	Acres Reclaimed.	Acres Cultivated.	Cost.	Cubic Feet per Second.
Se'ah Valley	22	6,000	1,000	$84,000	40
Yakima Valley Canal Co.	18	3,000	1,000	65,000	32
Takoma & Yakima Land Co.	12	.....	.....	42,000	.....
Natches & Cowiche	7	3,000	3,000	14,000	28
Union Broadgage & Schanno	1	5,000	4,500	18,000	45
Moxee Canals (3)	15	5,000	3,000	41,000	140
Yakima Investment Co.	42	50,000	10,000	600,000	700
Yakima Irrigation & Imp. Co.	81	18,000	1,100	100,000	329
Prosser Falls	8	3,000	1,000	42,000	28
Ahtanam Valley (small canals)	100	16,000	16,000	25,000	100
Natches Valley " "	12	8,000	8,000	6,000	80
Wenas Valley " "	8	4,800	4,800	7,400	36
Cowiche Valley " "	12	4,000	4,000	6,000	35
Moxee Artesian Wells (9)	.....	1,800	1,000	15,000	10

Nearly all the above are community ditches, the farmers under them having stock in proportion to the amount of land which they own, and the service of water is gaged accordingly. They elect their own officers, and levy a small annual assessment for repairs and to pay a ditch tender. The Yakima Investment Company is the principal exception. It owns one of the largest canals in the United States, being thirty feet wide at the bottom, sixty-two feet at the top, and over forty miles long. There are no reservoirs in the county, and all are gravity ditches, except the Prosser Falls Irrigation Company, which utilizes a part of the power in the falls about fifty miles from the mouth of the Yakima to run two large pumps to elevate sufficient water one hundred feet to fill its canal and irrigate three thousand acres.

The climate of Yakima is exceptionally good. The winters are mild and short, with much sunshine and little wind. While there is considerable wind in the spring, it is purely local, and on account of the sheltering mountains, never attains any destructive velocity. The summers are long and warm, with cool nights, and the autumns are delightful. The rainfall amounts to only about seven or eight inches annually.

The local hygienic conditions are admirable, and resident physicians assert that the climate is peculiarly beneficial in all asthmatic, pulmonary, bronchitic, neuralgic and rheumatic affections.

The long summers, with constant sunshine, abundant water for irrigation and the richest of soils, cause all products of the temperate zone to thrive luxuriantly. A crop failure in the valley is so far unknown.

The prune, plum, peach, persimmon, pear, apricot, cherry, apple and quince are grown to a size and with a flavor and keeping quality that is not excelled, if equaled, in any other locality. The fruit crop on the Pacific Coast was nearly a complete failure the past year because of a late cold, wet spring; but the orchards of the Yakima Valley were loaded with all kinds of fruit of superior quality. Small fruits and melons are equally productive and excellent.

Any vegetable raised in the United States can be here produced successfully. The asparagus and celery are especially fine, while the Yakima potato has already a wide reputation. Wheat, rye, barley, flax, corn, broom corn and sorghum are successfully grown. Alfalfa, the most ancient of all forage crops, thrives here to perfection, and yields, with four cuttings, from six to eight tons per acre annually. No forage plant has greater fat or milk producing qualities, and all stock thrive upon it remarkably. Red clover is almost equally productive.

As the surrounding hills and mountains are covered with bunch grass, cattle and sheep are fattened on the ranges for ten months of the year, and are fed alfalfa and clover the remaining two months. Diarying is also getting to be a large industry.

The quality of Yakima hops is very superior, and the yield is about three times as great as that of the fields of New York. The large yield, superior quality and relative low cost of production would seem to insure the future of the industry.

North Yakima, the county seat, is a beautiful town of about 4,000 inhabitants, centrally situated near the Yakima River, with all the principal valleys radiating from it like the spokes of a wheel. It is well laid out, has shaded streets, good water works, an excellent sewerage system, is lighted by electricity, and has flourishing churches and good schools. The Northern Pacific Railway follows the Yakima River through the county, and other railroads are surveyed and in contemplation.

YOUNG VINEYARD AND PEACH ORCHARD, YAKIMA VALLEY, WASHINGTON.

The four large cities of the Northwest, Portland, Tacoma, Seattle and Spokane, are almost equally distant, and with the many mining camps in the State, will furnish an abundant market for Yakima products.

THE ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA.

THE ninth annual meeting of the Geological Society of America was held at the National Museum in the city of Washington, from the 29th to the 31st of December, and was notable for the large number of members and visitors in attendance, for the number and value of the papers read, and for the harmony and good will shown in the discussions, in spite of the very varying opinions expressed by the disputants. The address of the retiring president, Prof. Joseph Le Conte, of the University of California, has already been given in abstract in the SCIENTIFIC AMERICAN, so that attention will be devoted in this account to some of the other papers on the programme. In all, fifty-one papers were offered for reading, but ten of these were omitted, on account of the absence of the authors, or for other reasons, so that forty-one was the actual number read and discussed. These took up so much time that it was found necessary to form a temporary section of petrography on the last day of the meeting in order to finish up the programme. An interesting feature of the sessions was the large number of lantern illustrations which accompanied and elucidated some of the papers.

The reading of scientific papers was begun by J. S. Diller, of the United States Geological Survey, whose subject was "Crater Lake." This remarkable body of water is deeply set in the summit of the Cascade range of Southern Oregon, and is noted for its beauty and depth, the grandeur of its encircling cliffs and its geological history.* During the glacial period the site of the lake was occupied by a huge volcano, comparable in size with Shasta or Rainier. Since then the upper third has disappeared and a pit 4,000 feet deep formed in its base. This pit is half filled with water, forming Crater Lake. The volcanic rocks, known as andesites and rhyolites, form the cliffs overhanging the lake, but basalts occur two to four miles distant on the flanks of the mountain. Very little debris is found in the region, and it is supposed that the pit was formed by the collapsing of the mountain, instead of by an explosion blowing it up. Wizard Island rises as a cinder and lava cone 800 feet above the surface of the lake, and contains in its summit a crater 80 feet deep. The pit is now about six miles in diameter, and probably has increased somewhat in size since it was first formed. The picturesque and instructive features of the lake were shown by means of lantern slides.

FOUR YEAR OLD BARTLETT PEAR TREE, YAKIMA VALLEY, WASHINGTON.

"The Leucite Hills, Wyoming," by Prof. J. F. Kemp, Columbia University. This paper described the two buttes known by this name, which are very briefly referred to by Prof. F. Zirkel and others in the reports on the geological survey of the fortieth parallel, and also the outlying Black Butte, which is beyond the limits of the atlas of those reports. These buttes are volcanic cones without craters, and are much like the volcanic plugs or necks of the Black Hills region. Zirkel described the rock as consisting of almost nothing but microscopic crystals of leucite, a mineral which at that time (1876) was considered very rare. Kemp, however, finds a much greater variety in the mineralogical composition, although leucite is very abundant.

The physiographic development of the District of Columbia region was discussed at some length by N. H. Darton, of the United States Geological Survey, who illustrated his paper by several topographic charts and many photographs showing the interrelationship of the deposits of the earlier stages of the coastal plain history of the region and the development of the present surface relief. A second paper by the same author announced the recent discovery of more diabase dikes and those of an acidic character among the Paleozoic rocks of central Appalachian Virginia.

Another paper dealing with early features of the land surface and its drainage was that by Frank Leverett, of the United States Geological Survey, and gave the results of studies on the changes of drainage in the Ohio River basin. The area drained by the Ohio is about 200,000 square miles, making it one of the largest river systems of the continent. In preglacial times, however, the system was divided up into several small systems, of which two are now deciphered. Drainage into the Tertiary interior continental sea probably extended as far up the river as Cincinnati. East of that point the area of which the present Scioto River is the center was drained by a stream flowing into Lake Erie, where the city of Cleveland now is, and farther east the waters of the Allegheny-Monongahela region also discharged into Lake Erie, but by their own outlet. The prime factors leading to changes of drainage are uplift, stream piracy and glaciation. An uplift took place in late Tertiary or in early Quaternary time, but the amount here does not seem sufficient to account for the changes of drainage. Stream piracy or the robbing of one stream by another cutting its valley had some effect as far east as Cincinnati, but the changes to the present river courses

* For description and illustration of this subject see SCIENTIFIC AMERICAN of December 5, 1896.

are mainly due to the enormous deposits of sand and gravel made by the glacier.

Dr. C. Willard Hayes, also of the United States Geological Survey, in a paper entitled "The Solution of Quartz under Atmospheric Conditions," brought to the knowledge of the society some curious phenomena recently observed by him in widely separated localities in the South. Silica is considered one of the most permanent compounds occurring in nature, but pebbles and bowlders of quartz, chert and chalcedony have been found which show the marked action of some solvent. All occur in heavily forested regions where there is an abundant supply of humus and humic acids and compounds. Forest fires are very frequent, and the resulting ashes furnish much potash to unite with the humic acid, forming an active solvent of silica. These humic acid compounds, therefore, are suggested as the probable cause of the etching of the pebbles and bowlders in question.

"Erosion at Base Level," by Marius R. Campbell, of the United States Geological Survey, was a paper in which some of the practical bearings of the preceding paper were shown. Many local base level plains in the Appalachian coal field show a sharp line of demarkation between the level floor of the basin and the surrounding slopes. Since the streams are too sluggish to mechanically transport the waste of the land, this condition can be explained only by supposing that most, if not all, of the material which is swept in from the surrounding slopes is removed by solution when it reaches the floor of the basin.

Etched quartz pebbles and geodes are evidence that under favorable conditions silica may be dissolved; therefore it remains to determine whether such conditions are liable to be present on a base level plain. The solution of the quartz appears to take place only in the presence of decaying vegetation; consequently, the swampy character of such a plain would offer almost ideal conditions for the removal of the silica as fast as it is washed in from the surrounding slopes. The alumina is still unaccounted for, but may not some similar reaction take place which removes this compound also?

Arthur Keith, another United States geologist, in some "Notes on the Structure of the Cranberry District, North Carolina," described some of the features of one of the iron producing regions of the South. The region is much folded and faulted, even for a part of the Appalachians. Igneous rocks of a basic character occur here in lower Cambrian sandstones and conglomerates which are of such character as to indicate the nearness of the shore line of that era. The axes of the folds and faults trend northeast and southwest. A great fault traverses the region from east to west, the minimum amount of thrust of which may be put at two miles, with probably a much greater displacement at some points. Metamorphism has affected the conglomerates so as to stretch out the pebbles they contain and produce a marked schistosity. The toughest portions of the conglomerate were rendered very plastic, as is shown by the distortion of quartzite pebbles in the conglomerate. The granites were not affected by the distorting forces, and, indeed, seem to have been the active source of movement.

A very short paper by Prof. C. H. Hitchcock, of Dartmouth College, announced a discovery which may necessitate the revision of much of the work on the New England metamorphic rocks. In some New Hampshire argillites, certain curved and crumpled quartz veins indicate lines of original bedding. Quartzites of the region show certain obscure curved lines, which indicate their original bedding. These important characteristics have not been observed until within a few months.

The attention of geologists has been strongly drawn lately toward Martha's Vineyard and Block Island, on account of Prof. Marsh's recent articles regarding the presence of Jurassic strata along the Atlantic coast. Much interest attached itself, therefore, to the paper by J. B. Woodworth, of Harvard University, on "Unconformities in Martha's Vineyard and Block Island." The paper was in part as follows:

"Beginning below, plant bearing beds of Cretaceous age appear in both islands without their base being exposed. On Martha's Vineyard marine Cretaceous strata overlie the plant beds; contact not worked out. Above the Cretaceous and on an eroded surface rests the Miocene of Sir Charles Lyell and W. H. Dall, composed of the (a) osseous conglomerate, (b) the green sand, (c) the yellowish green sand. There was erosion in the area between (a) and (b), probably also between (b) and (c). Fragments of a Pliocene formation have been detected at Gay Head; little is known regarding it. A marked unconformity now appears on Gay Head and Block Island at the base of the lowest Pleistocene bowlder formation. The Miocene was locally swept away at Gay Head. On Block Island this early Pleistocene rests upon the surface of the Cretaceous white clays, the Miocene being entirely unknown. There was probably some folding of strata at Gay Head before the deposition of this bowlder bed. After the deposition of from 25 to 50 feet of compound gravels and sands, more folding took place over Martha's Vineyard and Block Island. The Mohegan Bluff beds on Block Island and the Tisbury beds on Martha's Vineyard, of glacial origin, were now laid down on eroded surface of folded older strata. In the Vineyard subepoch of erosion the islands were deeply denuded; then followed the last glacial epoch with deposition of moraines and sand plains."

A day's time of the convention was occupied by the glacialists, who had on the programme the titles of thirteen papers pertaining to their specialty. Prof. R. S. Tarr, of Cornell University, led the way with a description of Cornell Glacier, located in central western Greenland, near the southern end of Melville Bay, which he and a party of his students studied carefully last summer. Near the shore this glacier is divided into two parts by a nunatak, or pinnacle of rock rising through the ice sheet. This nunatak and other masses of rock, rising high above the ice floes, are very angular on the side toward the ocean, but they are rounded on the inland side toward the ice and support bowlders, pebbles and clay, showing that once the glacier covered them. The positions of the moraines indicate that the glaciers are now retreating. It is not probable, however, that the Greenland glacier can be regarded as being a remnant of the great glacier that covered the northern part of the continent of North America.

Another member of the same Greenland party, Prof. G. H. Barton, of the Massachusetts Institute of Technology, gave the society a paper based on his studies in the far North. His paper, "Glacial Observations in the Umanak District, Greenland," embodied the results of studies upon the margin of the inland ice for a distance of about fifteen miles from the nearest land. He found the marginal edge to be of very steep slope or vertical, then came an area of dust holes, beyond which was a region of billowy surface and then a smooth, level expanse as far as could be seen. Prof. Barton noted ice walled lakes, with small tributary streams, large streams and springs of great force. Measurements of the rate of motion were made, and in one place seemed to indicate the presence of a regular eddy in the ice.

Prof. H. F. Reid, of Johns Hopkins University, read a paper on the "Mechanics of Glaciers, Moraines and their Classification," presenting some of the results of work on the Forno glacier in the Alps the past season. What is usually called the "ribboned structure" is probably the outcrop of strata in the ice, as contended for by Louis Agassiz. Moraines require a new classification into: First, those which have their origin below the névé line; and, second, those which have their origin above it. The latter present characteristics which have not heretofore been carefully described. One peculiarity of the material forming the second class is that it emerges from within the mass of the glacier at its end. Prof. Reid is a member of the international committee on glaciers, which is collecting all kinds of data regarding their phenomena. He reports that the information received indicates that at present the glaciers all over the world are retreating, except those of Nova Zembla, which seem to be advancing.

"The Assumed Glaciation of the Atlas Mountains of Africa" was the title of a paper by Prof. Angelo Heilprin, of Philadelphia, in which were brought out some interesting facts regarding that little known country from a recent personal visit. Vast bowlder and pebble deposits cover a large part of the region of North Africa, both at sea level and on the inland plateaus (and mountain slopes), to 3,000 feet elevation and more. These have in places much the appearance of morainic and true drift material, and as such have been described by some geologists and geographers. But their relations are with oceanic and torrential modeling of the land surface and they give no basis for the supposition that ice action was involved in their making. Neither on the highest points of the Atlas Mountains, in Algeria, nor on their slopes, were any evidences of glaciation met with.

The ancient glaciation of the valleys of the great lakes and the vicinity received its usual large amount of attention. The first paper on the subject was by Prof. H. L. Fairchild, of Rochester, "The Shorelines of Lake Warren and of a Lower Water Level in Western Central New York." The beach of this glacial lake has now been traced with practical continuity from Crittenden, N. Y., where it has long been known, eastward to beyond the meridian of Rochester. It has an altitude of about 880 feet above tide. A lower beach of good development, with an altitude of 700 feet above tide, has been traced for a considerable distance, and other evidences of static water of this level extend over a wide area.

The next paper, on "Old Tracks of Erian Drainage in Western New York," by G. K. Gilbert, of the United States Geological Survey, also dealt with phenomena of the retreating ice sheet. The last stage of Lake Warren was ended by the shifting of the outlet for the waters of the great lakes from Michigan to New York. Between that time and the establishment of the Niagara River, the discharge from the Erie basin crossed western New York on lines determined by the relations of the shifting ice margin to the topography and entered the Mohawk Valley, thus reaching the Hudson.

One of the features of the history of the great lakes has been the discharge of the waters of the upper three of them by way of Lake Nipissing and the Mattawa River to the Ottawa. F. B. Taylor, of Fort Wayne, Ind., made a special study of the region during the autumn just past and gave the society a résumé of the results obtained. He said in part: This outlet river is called the Nipissing-Mattawa River, and the three upper great lakes of that time are called the Nipissing Great Lakes. The Nipissing beach is well developed at North Bay at an altitude of about 700 feet above sea level. On the swampy col between Lake Nipissing and Trout Lake it was a little over a mile wide, with a maximum depth of about thirty feet and an average of

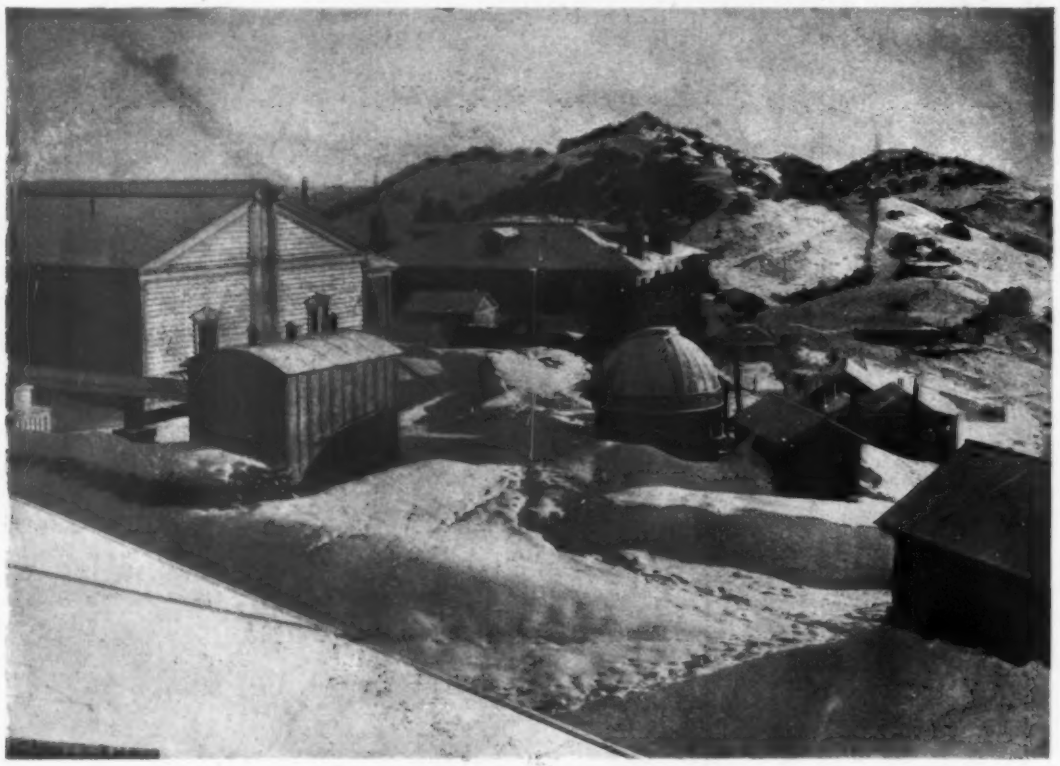
SILVER PRUNES, YAKIMA VALLEY, WASHINGTON.

from ten to fifteen feet. The beach is faintly but clearly marked to the foot of Trout Lake and the shore mark of the river in expanded portions and at some of its rapids was found at several points below. The best evidence of the existence of the ancient river was found where it crosses the course of a bowldery moraine deposit. The bowlders in such rapids were scoured by the sand and pebbles moved along by the current into peculiar forms readily recognized. These rapids were located at moraine crossings. Others were less certainly determined. The place of one cataract was also found about midway of the length of the present Mattawa River. In one of its rapids the ancient river was between 600 and 700 feet wide, with an average depth of thirty-five to forty feet. This corresponds very closely, in a general way, with the size of the modern St. Clair and Detroit Rivers. The remains of the ancient river agree with the Nipissing beach in indicating that this arrangement of the upper great lakes endured for a relatively long period of time.

Prof. J. F. Kemp has been spending much time in field work in the eastern Adirondack Mountains, and he has discovered outlying areas of Paleozoic strata far within the border of the region which have enabled him to trace out some of the points of pre-Cambrian topography. The recent completion of several of the atlas sheets of the United States Geological Survey has made it possible to illustrate the matter quite fully and with comparisons of present altitudes. The author showed that the early Paleozoic sea apparently set up into narrow embayments in what were doubtless old submerged valleys, which, being now indicated by the outliers, enable us to reconstruct in a general way some features of the old topography. The abundance of Potsdam sandstone bowlders in the drift far in the hills leads to the conclusion that the Potsdam was probably more abundant in the interior before the ice invasion than now.

"A Study of the Nature, Structure and Phylogeny of Dæmonelix" was the title of a paper by Prof. E. H. Barbour, of the University of Nebraska, dealing with one of the strangest fossils discovered in recent years and one over which there has been much discussion as to whether it is the remains of a plant or the cast of the burrow of some animal. The author of this paper, who was the one to bring these strange fossils to the knowledge of the scientific world, says that Dæmonelix is a fresh water algous plant. It occurs in various forms, the chief of which are large, regular, upright spirals, sometimes with an axis, but sometimes without, like a corkscrew. They occur in every exposure in the Loup Fork Tertiary on Pine Ridge, Sioux County, Neb., over an area of about 500 square miles. They stand invariably upright in fairly coherent sand rock through a vertical range of about 200 feet. Structurally the fossil is cellular but not vascular, and consists of simple parenchymatous tissue without trace of fibro-vascular bundles. In its phylogenetic relations we can trace apparent development from the simple Dæmonelix "fiber" in the lowest beds, successively through the "cakes," "bails," "cigars" or "fingers" and the "irregular" to the regular spirals of the topmost beds. Though the development is too sudden and startling, nevertheless this is the order of occurrence. The paper was illustrated by numerous specimens and lantern slides.

The other papers read at the meeting were as follows: by Marius R. Campbell on the origin of certain topographic forms, in which was discussed the effect of climate, character of rock and declivity in a portion of the southern Appalachian Mountains; by J. B. Woodworth on the homology of joints and artificial fractures; by H. W. Turner on the work of the United States Geological Survey in the Sierra Nevada; by Frank Leverett on the relation of an abandoned river channel in eastern Iowa to the western edge of the Illinois ice lobe; by F. B. Taylor on moraines of recession and their significance in glacial theory; by Prof. F. D. Adams on the origin and relations of the Grenville-Hastings series in the Canadian Laurentian rocks; by Prof. J. E. Wolff on the age of the white limestone of Sussex County, New Jersey, giving his reasons for believing it to be pre-Cambrian; by Prof. H. S. Williams on the Southern Devonian formations; by Dr. David White on the age of the lower coals of Henry County, Missouri; by Dr. H. B. Kümmel on the structure of the Newark formation of western New Jersey; by Prof. W. B. Clark on the upper Cretaceous formations of the northern Atlantic coastal plain; by T. W. Stanton on the stratigraphy and paleontology of the Laramie and related formations in Wyoming; by Prof. I. C. Russell on the geology of northeastern Washington; by Dr. G. P. Merrill, some notes on rock weathering; by Dr. C. W. Hayes on the crystalline and metamorphic rocks of northwest Georgia; by Dr. A. C. Lane on the grain of certain rocks; by Prof. Florence Bascom, some notes on the South Mountain, Pa., volcanic rocks; by Prof. Emerson on the Triassic trap rocks of the Connecticut valley in Massachusetts.



THE SUMMIT OF MOUNT HAMILTON IN THE WINTER.

MOUNTAIN OBSERVATORIES.*

IN the early days of telescopic observation the astronomers were satisfied if the instrument were perfect. Galileo and Kepler (1609) considered the telescope alone; but Newton (1717), whom nothing escaped, saw that vision might be better in the pure air of high mountains.

Sir William Herschel was the first to consider the observer as a part of the apparatus. In 1782 he points out that to obtain the best results the observer, the air, and the instrument must be of one temperature. In 1794 he says, while reobserving the belts on Saturn and noting changes that had occurred: "I took care to bend my head so as to receive the picture of the belts in the same direction as [formerly], as there was a possibility that the vertical diameter of the retina might be more or less sensitive than the horizontal one."

The investigations of Gauss and others for the telescope, and of Helmholtz and others in the optics of the eye, have taught us the imperfections of both these optical instruments. Newton's suggestion of 1717 has been carried out, in one form or another, by Bond (1851), Lassell (1853), Piazzi-Smyth (1856), and others, and has resulted in the foundation of mountain observatories like those of Mount Hamilton, Etna, Nice, etc. Galileo's tower at Arcetri is the forerunner of the magnificent establishments of modern times. The greatest telescopes of the world are but consequences of his "optick tube."

The inhabitants of the earth know the external universe directly only through the sense of sight; and our terrestrial views of the planets and stars are much modified by the action of our own atmosphere upon the rays of their light which reach our eyes. We are, as it were, immersed in an ocean of air, and one of the first problems of astronomical physics is to determine the effect of this overlying ocean upon the light from external bodies which penetrates its depths. Light moves in straight lines in empty space; but light entering our atmosphere is refracted from its course, so that the ray which enters our eye from a star no longer travels in its primitive direction.

By the effect of refraction every star is seen, not in its true place, but displaced. Moreover, the atmosphere does not permit all the light of the star to reach us. A certain quantity—percentage—is absorbed in its passage through the atmospheric envelope, and the star appears fainter to us, in fact, than it would were the atmosphere removed. It appears less bright near the horizon than near the zenith. Not only is the quantity of incident light changed by the general absorption, but its quality is affected also by a selective absorption special to our air. Bodies appear redder than they really are. The blue light is more absorbed, proportionally, than the red. A familiar example of this is shown in the redness of the setting sun. If we measure the heat which comes to us from the sun, we shall find that it is refracted, altered in quantity and also in quality by our own atmosphere.

One of the chief problems of astrophysics is to evaluate the amount of these alterations, so as to obtain the true and not merely the apparent effect of celestial radiations.

In order to measure the effect of the earth's atmosphere in these regards there are two obvious experimental methods. The observer may, first, remain in the same place, and make his measurements when the heavenly body is near the zenith (when its rays traverse the least depth of air) and again when it is near the horizon (when its rays traverse the maximum depth). By a comparison of such observations the effect of the atmosphere can be concluded. Or, again, the observer may occupy two stations, one near the sea level (and thus under the whole of the atmosphere), the other on a high mountain (and thus free from the effect of the air beneath). A comparison of such measures will, again, determine the influence of the earth's envelope. In many of the delicate problems of astronomy and physics, recourse must be had to both these devices. High level observing stations are called for in many special researches.

Stars seen from the summit of a high mountain of about 10,000 feet in altitude appear considerably brighter than from sea level, and the effect to an observer seems to be a brightening of the whole heavens.

This brightening is, however, not uniform over the entire sky. Stars at and near the zenith are but slightly more brilliant, while those near the horizon are about two and a half times brighter than at sea-level. The very vivid impression made upon an observer who first sees a clear night sky from a high peak is chiefly due to the marked increase in the brilliancy of the stars, and of the Milky Way, close down to the horizon.*

If, while the stars are more brilliant, because the air is more transparent, they are at the same time more steady (twinkle less), because the air is more tranquil, the advantages of a mountain station for astronomical purposes become very great. If these advantages are noteworthy for observations made with the eye and telescope, they are still more so when the eye is replaced by the photographic plate. The blue rays pass through the higher air relatively more freely than through the lower and denser.

At the Lick Observatory both the advantages named above are secured; that is, increased transparency and greatly increased steadiness. The astronomical observations made on the Santis show the same to be sometimes true at this station, though both advantages are rarely secured at high mountain stations.

In astronomical observations it is desirable that the image of the star under examination should be as bright as possible; and as steady as possible—as free from twinkling, as has been said. Of the two requirements the second is far more important for all observations in which accurate measures of the positions of stars are needed; and in most spectroscopic observations.

A transparent air is very desirable; a steady air is essential for most astronomical work.

The conditions which produce steady seeing depend, in general, upon the arrangement of the layers of atmosphere above the observing station. If we imagine the observer to be situated on an extensive level plain, as on the steppes of Russia, a small island in the tropical ocean, or the plains of Lombardy, and if the air is

* Condensed from "Mountain Observatories in America and Europe," by Dr. Edward S. Holden, in Smithsonian Miscellaneous Collections.

* At an elevation of 14,000 feet in the Sierras and Rocky Mountains the sky, on a cloudless and smokeless day, is violet, not blue. The skies of the paintings of Bierstadt, Moran, and others seem false to those who have never lived at these high altitudes, but they are not so.

quite still, the separate layers of the atmosphere will be arranged in strata parallel to the earth's surface. The lowest stratum will be the warmest, the highest the least warm. The transition from the temperature of one stratum to that of the next will be gradual and regular. The changes of moisture and of density in the various strata will be gradual and not abrupt.

A ray of light from a star falling on such a series of strata will pass through them all in a regular, smooth curve. In the telescope no twinkling of the star image will be noticed.

Now if some of these strata are very cold, while the adjacent ones are warm, the atmosphere in such regions will be in rapid and irregular motion. The warm air below will be rising through the cold strata above and the air of the latter will be falling. These motions are necessarily irregular and complex. If a strong wind is blowing in these regions, the rapidity and complexity of the changes may be increased. A ray of starlight will pass through such a mixture in a zigzag line with a thousand small irregularities, and these will produce variations in the image seen by a telescope. Let us first consider the sidewise motions of the star image. To the naked eye these may appear quite considerable. In the telescope they will be multiplied by the magnifying power used.

Besides the sidewise motion of the star image produced as described, the motions of the layers of atmosphere give rise to other effects. They virtually change the focus of the observing telescope, as follows: The object glass of the telescope is a lens which grasps parallel rays and brings them to a definite focus. The eyepiece is placed so as to see the image at the focus as sharply as possible. A change of a few thousandths of an inch in the position of the eyepiece may be fatal to good definition of the image. If we should suddenly change the object glass of the telescope and replace it by another of slightly different focus, say a few tenths or even hundredths of an inch different, leaving every thing else the same, it is clear that accurate vision would be destroyed. A perfect image of the star would be formed in the focus of the new object glass, but the eyepiece would no longer be in the correct position with reference to the new image, and the vision would be unsatisfactory.

An effect precisely similar to the sudden changing of object glasses is frequently produced by the sudden changing of the curvature of the layers of air in front of the telescope. These layers, which were, let us say, at first horizontal, are suddenly bent by air currents so as to have a decided curvature and so that they act like lenses upon the incident starlight.

The ray from the star which at first came to the true focus of the glass lens of the telescope is suddenly brought to a new focus, whose position is fixed by the combination of the air lens, so to say, and of the glass lens. Measures of the curvature of such atmospheric strata have been made, and their radii of curvature have been shown to be at least as small as 6,600 feet. An air lens of this curvature in front of the object glass of a large telescope will change the place of the image by several hundredths of an inch. The eyepiece, which remains at one place, can no longer give an accurate image, and the definition is thus spoiled.

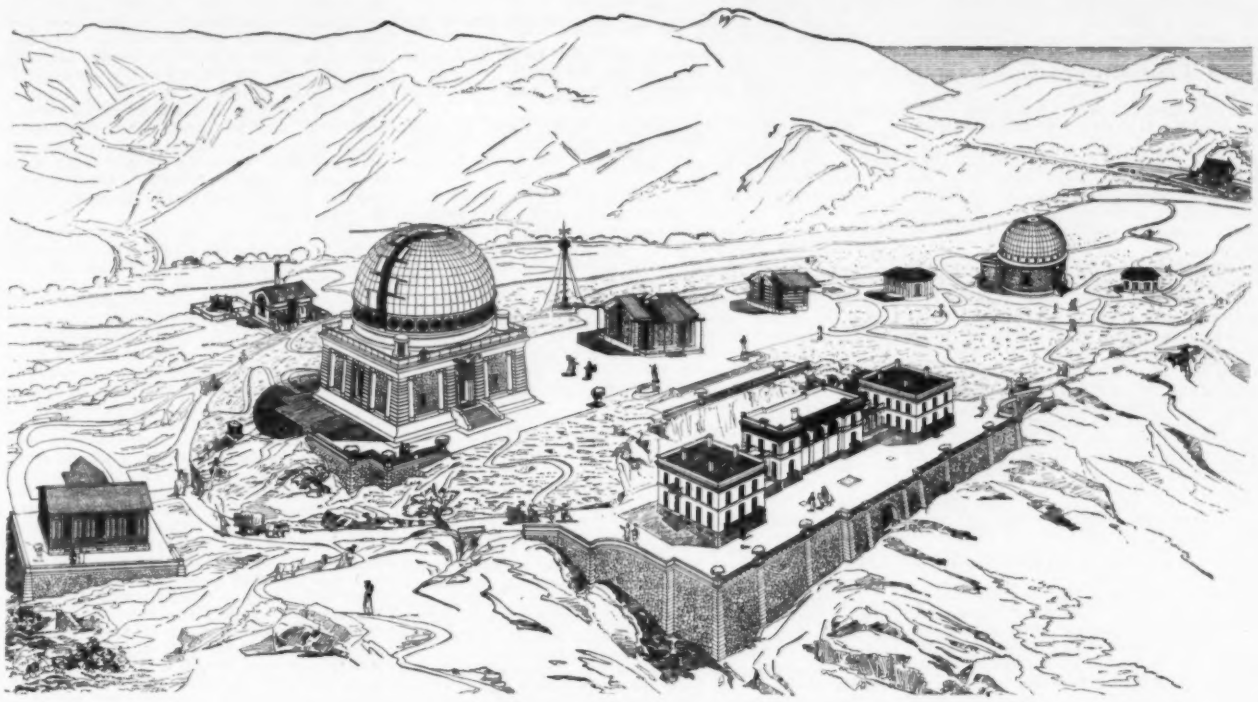
The foregoing elementary explanation supposes the change of focus to take place with some regularity. In practice the changes are usually very irregular, so that, for example, it would be quite impossible to alter the poition of the eyepiece to a place suitable for seeing the new image.

The twinkling of stars also produces marked changes in their colors. A bright star, near the horizon, will show these changes to the naked eye. In the telescope, and especially in the spectroscope, they are very obvious, and at times quite fatal to measurements. They are all due to changes in the temperature and arrangement of the strata of the atmosphere, and are only absent when these strata are arranged concentrically in parallel layers.

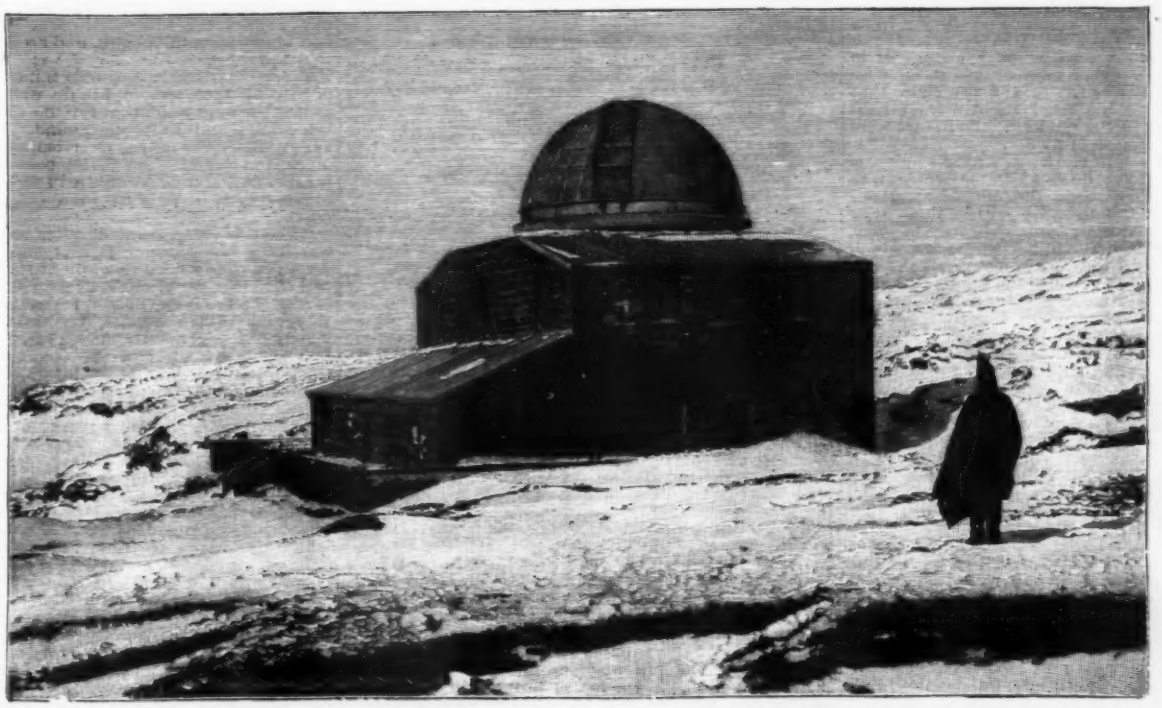
The deformations of star images and of star spectra have been studied by Arago, Secchi, Dufour, Montigny and others, to whose memoirs reference is made in passing. The object of the foregoing paragraphs is simply to describe the general effects of bad definition—bad seeing—due to inequality in the distribution of temperature in the atmospheric strata in the neighborhood of the observer. These effects are more apparent the larger the aperture of the telescope employed and the greater its focal length.

More bundles of rays, coming from more directions, fall upon a large object glass than upon a small one. The changes in focal length due to "air lenses" are expressed in per cent, of the focal length itself, and hence the absolute displacement of the disturbed image, in inches, is greater when long telescopes are employed. It is for these reasons that it is especially necessary to select suitable sites for the emplacement of the large telescopes of modern times. The study of the conditions of seeing at mountain observatories thus becomes of capital importance.

In a general way it may be said that the air strata over an extensive plain arrange themselves horizontally. On a mountain peak, however, they are necessarily curved, except when a complete calm prevails, and when, also, the temperature conditions are the same for considerable distances above and below the peak, if the whole air is clear, or from a considerable distance



THE ASTRONOMICAL OBSERVATORY OF NICE (1,100 FEET).



THE ASTRONOMICAL OBSERVATORY ON THE SUMMIT OF ETNA (9,652 FEET).

above the peak down to the upper surface of an extensive fog layer itself lying some distance below the summit. The last arrangement describes the usual summer conditions at night on Mount Hamilton. A capital merit of our climate is that the vision usually continues good during the entire night if it is good at the beginning.

An important advantage to be sought for in the site of an astronomical observatory is the continued clear weather. Much time is spent in preparing for observations; and this is time lost if the observations are prevented by clouds or fogs. If one is sure of good weather, a programme of observation may be made weeks beforehand, and carried out to the letter at the appropriate time.

The observatory of Algiers probably has fewer clouds than any other. In 1883 the sun was photographed there on 310 days.

Southern California, Egypt, Arabia, Madeira, Peru, parts of Australia, etc., have excellent records in this regard; not all of these regions are suitable for refined astronomical observations, however, as several of them fail in respect of the most important condition, namely, steadiness of the air.

The advantage of a suitable station for astronomical work can be strikingly illustrated by a comparison. Dr. Lewis Rutherfurd made hundreds and hundreds of negatives of the moon, only a few of which are of high excellence, the sole cause being the very unfavorable situation of his observatory in the city of New York. Dr. Henry Draper, in 1877, reported that only three nights in two years gave him good lunar photographs at his observatory at Hastings-on-the-Hudson, where the steadiness of the air was not satisfactory.

During August, 1888, photographs of the moon were made at Mount Hamilton on the following dates. All the negatives were fairly good and those marked with a star were very good; with two stars, excellent: August 12*, 13*, 14**, 15**, 16, 17, 18, 19 (no observations—Sunday), 20, 21, 22, 23*, 24*, 25, 26*, 27*, 28*, 29 (no observations—the sky was clear), 30*, 31*.

All the nights were clear—nearly all were good—and at least two of them were superb.

High level meteorological observatories will always be needed, in spite of the fact that their records are necessarily much affected by merely local conditions. The improvement of self-registering instruments, running for long periods, will enable such establishments to dispense with a large staff of observers.

The development of methods of observing by instruments in balloons and on kites will do away with the necessity for a great number of mountain stations. A given amount of money expended in securing such observations will, without doubt, produce the maximum of useful result.

The observatory on Etna was first proposed by Prof. Tacchini, in June, 1871, although his idea was not realized till 1881. As at present organized, it is an annex of the observatory of Catania. The 35 cm. (13·8 inch) equatorial of the two observatories has a single object glass and two mountings, one at each station. During the favorable season, July to October, the lens is mounted at the summit, while it is employed at Catania for the remainder of the year. The Etna station is reached by a drive of about eleven miles over a carriage road to Nicolosi, and from thence on horseback in six hours, provided the trail is not obstructed by snow.

Several important series of observations, having for their object the determination of the relative advantages of high and low level observing stations, have been carried out on Etna by Tacchini, Langley, Hale, Ricco and others. They need not be referred to in detail here. The detailed report of Prof. Hale and the general conclusions of Prof. Tacchini, which follow, seem to give all the information of special value for our immediate purpose.

Prof. G. E. Hale spent some time on Etna in 1894 in an attempt to photograph the solar corona in full sunshine. His notes on the purity of the sky show that the blueness of the sky increased slightly from 1,450 meters (4,757 feet) up to the summit. The stars were unsteady even at the zenith (July 8).

"On July 9 the sky was clear. A strong wind was blowing the smoke from the great crater (which rose behind the observatory to an altitude of 3,312 m., 10,866 feet) away from the direction of the sun. Half the island of Sicily was dimly visible through a great brown bank of thick haze, the upper surface of which seemed to be nearly on a level with us. The sun was seen (between clouds) to be surrounded with a bright halo. In the afternoon the sky became much whiter.

"On July 10 the wind blew the smoke of the great crater over the sun, making the sky very white. The image of the sun was rather better than at Catania, but it became unsteady later. At 10 h. the sun was surrounded by a white halo, and clouds of insects were noticed as at Pike's Peak in 1893.

"July 11. The sky was very white with a bright ring around the sun. The seeing was excellent.

"July 12. The sky was very white, and there was a bank of haze above the level of the observatory. The smoke from the crater was blown over the sun. The sky seen from the summit of the great crater was bluer than when seen from the observatory. The whole island was enveloped in haze. The seeing (at night) on the moon, Saturn, and stars was magnificent. The images were almost perfectly steady with the highest power. With the naked eye the twinkling of the stars was hardly perceptible in stars higher than 30°.

"July 13. Sky cloudless and generally whitish, but the best seen since July 9. Much dust. The definition on the sun was poor.

"July 14. The whole eastern sky was white. Left the observatory this day."

These notes of Prof. Hale's seem to show that the smoke from the crater produces a whitish sky, as is a priori probable. On one occasion the definition was of high quality. It is Prof. Hale's opinion that the sky at Pike's Peak is considerably more pure; and this, again, is a priori likely to be the case. The forest fires and the dust from the plains to the east and from the South Park to the west would seem to be the chief sources of solid particles in the surrounding air, and all these taken together are not likely to produce as much effect on the transparency of the sky as the smoke from Etna's crater.

The favorable season on Etna is comparatively short, from the middle of July till early October. The mean temperature of July at Casa Inglese (about 9,000 feet above sea) is about + 5° C. (41·0° F.), the highest is about + 13° C. (55·4° F.) and the lowest about — 1° C. (30·2° F.)

I have applied to my friend Prof. Tacchini for his judgment of the astronomical conditions on the summit of Etna, and the paragraph which follows is extracted from his reply, dated January 23, 1896, to my letter of inquiry. This verdict must be accepted as entirely authoritative in all respects.

"Quant à mon opinion sur les questions posées par vous, voilà ma rèponse:

"1°. The sky is certainly markedly purer and more translucent on Etna than at the sea level.

"2°. The stars are markedly more steady on Etna than lower down.

"Mais, comme vous dites, suelement dans les meilleures conditions d'observation, qui, dans les observatoires très-élevés, ne sont pas aussi fréquentes comme on peut le croire."

The observers at Nice have been too much occupied with making valuable observations and discoveries to devote any considerable amount of attention to investigating the conditions of the atmosphere on Mont Gros, but their published volumes enable us to give a rough estimate of the steadiness of the atmosphere there. In the double star measures of M. Perrotin with the 15 inch telescope, magnifying powers of about 1,000 diameters were habitually used. Each measure of a star was marked a, b, c, according as the images were good, pretty good, or moderately good.

I have had the curiosity to count the number of times each letter occurs, as follows:

From June, 1883, to August, 1886:

a occurs	477	times
b "	1,282	"
c "	197	"
Total	1,956	"

When the images where of class c it is obvious that few measures would be made. It is not necessary, nor perhaps practicable, to deduce a numerical estimate of the average observing weather at Nice during this period for comparison with that at other observatories. It is obvious that the conditions are excellent, and distinctly better than at most observing stations.

Under good circumstances the transparency and purity of the sky at Nice are remarkable. If the disk of the sun be hidden by a screen there is no "glare" in the field even close to the point of tangency. For a time this transparency was lost, during the time of the Krakatoa eruption and the red sunsets, but it appears to be the normal condition. M. Thollon remarks (vol. II, p. E. 23) that the great comet of 1882 was seen by day from Mont Gros.

HEIGHTS OF MOUNTAIN OBSERVATORIES.

It may be a convenience to have the following small table of the heights of the principal mountain observatories and stations of the world:

Abastouman	4,600	Mount Hamilton	4,209
Alto de los Huesos	13,300	Mount Pilatus	6,785
Arequipa	8,060	Mount Washington	6,370
Ben Nevis	4,368	Mount Whitney—summit	14,900
Chachani—summit	20,000	Mountain Camp	12,000
Station	16,650	Lone Pine	3,700
Colorado Springs	6,035	Mount Wilson	6,000
Cusco	11,000	Murren (railway)	5,350
Denver (Chamberlin Observatory)	5,400	Nice, Mont Gros	1,100
Echo Mountain	3,500	Petropolis (Brazil)	3,500
El Misti summit	19,200	Pic-du-Midi	9,439
Station	15,600	Pike's Peak	14,134
Etna	9,652	Popocatapetl	18,000
Flagstaff	7,300	Puno	12,608
Jungfrau	15,700	Puy-de-Dome	4,593
Kodiakanal	7,700	Quito	9,543
La Joya	4,150	Rigi	5,873
La Paz	12,050	St. Bernard	8,130
Lick Observatory	4,209	Santa Ana	3,000
Misti—summit	19,200	Santis	8,200
Station	15,600	Seven Lakes (Colorado)	10,264
Mollendo	100	Sherman	8,335
Mont Blanc—M. Jarassen's Observatory, summit	15,780	Sonnblick	9,843
M. Vallot's observatory	14,321	Tacubaya	7,500
Chamounix	3,396	Teneriffe—summit	12,198
Mont Gros (Nice)	1,100	Alta Vista	10,702
Mont Meige	13,000	Guajara	8,903
Mont Mounier	8,998	Vinocaya	14,360
		Wendelstein	6,027

IN UNEXPLORED ALASKA.

THE REV. FATHER TOSI'S REMARKABLE JOURNEY OF 2,000 MILES.

OF all people who have been in or traveled over Alaska, it is safe to say none of them has seen the sights to such an extent or covered the territory so thoroughly as the Rev. Father Tosi, Prefect Apostolic of Alaska, who has spent the past three months in Juneau. The reverend gentleman has been from the island of Attu through the Aleutian Archipelago to the most northern point in Alaska, Point Barrow. During his residence of ten years in the Yukon Valley he has traveled thousands and thousands of miles over territory never before invaded by human beings. Three years ago he, in company with but an Indian boy, made the trip from the mouth of the Porcupine River overland in sleds in an air line to the Arctic Ocean, an unknown country of which no one knew anything; a trackless waste totally devoid of animal life of any description and containing not a stick of timber as large as one's thumb. This was but one of numerous journeys of like description, all made with but one object, the hardships endured and dangers braved with but one point in view—the amelioration of mankind in general and of the Indians of the interior in particular. Such is the life work of one who has already sacrificed a decade in the frozen North, and who, in the early spring, will return to the labor he loves so well.

Father Tosi possesses an inexhaustible fund of reminiscences, tales of adventure and of travel, and an evening spent in his company would be not only highly entertaining but profitable as well. An account of a journey made by him last summer to the head of Kotzebue Sound, and several hundred miles inland, cannot fail to prove of interest. That part of Alaska is entirely a terra incognita, and, to the miners looking for a new country, there they will find rivers and creeks which have never had a pick struck in any of their banks or a shovelful of gravel turned over on any of their bars. The tale will be best appreciated in the father's own language:

"I had heard through Indians whom I met, both on the Yukon and on the coast, of the existence of populated and prosperous villages on the streams which empty into the Kotzebue Sound, villages whose inhabitants were as aboriginal as they were centuries ago. These Indians come to the nearest trading points but once a year, and there had never been a white man among them. In making the trip I had several objects in view, first and foremost of which was the establishment of a mission and a school. Then, too, I had a great desire to see the country, and I thought it might be possible to establish communication between Nulato and the head of Norton Sound. The trip necessarily had to be made in winter on sleds, and with but an Indian boy for company I left Kozrefski, our station on the Yukon, February 15, 1895. I took but one sled and had ten dogs in our team. The ice was in splendid condition and we made good time, the first halting place being at the Akulwek mission, on the south fork of the Yukon, 800 miles distant from home. Here we remained a day and then started across the Yukon delta in a direct line for St. Michael's, which we reached four days later.

"Here I sent the Indian boy home, and was happy to have join me Dr. Crew, who was spending the winter on the islands. Our outfit was increased by another dog team belonging to the doctor, and after spending two days at St. Michael's completing all the details for the trip, we set out for the unknown country. At the start the ice was very good, but within a few hours a treacherous south wind blew up, and, almost before we knew it, the ice upon which we were traveling was floating with the tide. We at that time were about forty miles from land. As soon as we became aware of our perilous position we lost no time in making for solid ground. Ere we had traveled many miles the ice began breaking into smaller floes, and frequently we would be compelled to make a detour of considerable extent in order to gain a comparatively short distance toward the shore. The thermometer was ten below zero, but we suffered none whatever from the cold until Dr. Crew had the misfortune to slide into the water. As he was falling he had the presence of mind to grab the sled and he was easily pulled out by the dogs; otherwise he would probably have been drowned. We finally reached the land, after many narrow escapes, and continued our journey overland. The traveling on the shore was anything but pleasant, over rocks, hills and brush, and we were tempted to get back on the ice, which, though separated from the shore by three or four feet of water, looked strong enough.

"It required two days to reach Unalalik, a trading station on the sea near the entrance to Norton Sound. A trader was located here by the name of Englestadt. Upon being told our destination he expressed a great desire to accompany us to the new country, to which we made no objection. He took an Indian with him also. Beyond Unalalik we found good ice again, and continued our journey on it to Norton Sound, thence to the head of that body of water. The weather became very cold, the thermometer falling to 40° below zero. Three times in one day Dr. Crew froze one of his cheeks and his nose. On an unnamed river of considerable size which flowed into Norton Sound we found a village of about 200 Eskimo or Innuit Indians, who spoke the same language, with a slight difference in dialect, as those of St. Michael's. They had plenty to eat and their houses were comfortable. We followed this river to its head and crossed the divide between Norton Sound and the tributaries of Kotzebue Sound. A strange peculiarity of this country is the total absence of any timber whatever, excepting in a small spot on an island about three or four acres in extent. Here nature has seemed to mock at the immediate surroundings, for she has been more than bounteous in supplying this small oasis. The trees are eight and ten inches in diameter, and are so close together as to make this miniature forest well nigh impenetrable. Prospective travelers and also miners who may think of visiting that section will do well to remember this, as it is the only wood that can be found between Norton Sound and Kotzebue Sound. It is located about twenty-five miles up the river emptying into the head of Norton Sound. The divide between the two sounds is quite flat, and no trouble whatever was experienced in crossing it, it requiring but one day to make the trip.

"The first camp we made after crossing the summit was on a small stream flowing into Kotzebue Sound. Along its shores were vast quantities of willow brush of the thickness of one's finger. Another peculiarity of this section is the immense quantities of small game we found. Small rabbits, Arctic hares, and those delicious ptarmigan were encountered everywhere. We killed a great many of them, and we not only had a feast ourselves, but gave the dogs a much relished change of diet. On the shores of Kotzebue Sound we found Miner Bruce's partner, a man named Gibson, who is running a trading station there. He seemed happy and contented, although he never sees people of his own race but once a year. Crossing the head of Kotzebue Sound, we entered the Selawik River, one of the principal tributaries of the sound. We continued up this river for a number of miles, when to our surprise we found it widened out and became a beautiful lake from twenty to thirty miles wide and fifty miles long. This lake we found dotted with many small villages containing twenty-five to thirty houses. Passing through the lake, we again entered the Selawik River and continued our travels up the stream for three days, a distance which we judged to be about eighty miles. The river forks at this place, and a small settlement of probably half a dozen houses lies on the right hand fork. The first person we encountered was an old man, who was assiduously engaged in making hoochinoo, the only sign of liquor we found upon all our trip. Whether he was merely making some for home consumption or for sale I did not learn. This village is Corbonna, and is situated in one of the most beautiful and attractive spots in all Alaska. There is plenty of timber at hand, fir and birch, and the country seems overrun with game. In the woods can be found great numbers of deer, caribou and bear, and the rivers and creeks abound with fish, salmon, trout and whitefish being very common and easy to catch. Fur bearing animals are also very plentiful, white foxes and beaver in particular. They also find land otter and red foxes in great numbers. In the summer time these Innuit Indians all emigrate to Atom Island

in Kotzebue Sound, where they meet whalers and exchange their furs, ivory and curios for molasses, tea, flour and hard tack.

"It is not an infrequent occurrence to find 2,000 of these natives congregated on Atom Island at one time. They treated our party very hospitably, and seemed rather loath to have us leave. From these Innuits I learned that it was practicable to establish overland communication between Kotzebue Sound and Nulato, on the Yukon. The Selawik River heads in a low range of mountains, on the opposite side of which a fork of the Koyukuk finds its source. Indians have made this journey in six and seven days, and found native villages in which to stop overnight each evening but one. By this route we would have reached home in a week, and saved over 600 miles. Traveling, the Indians say, is good, and wood can be found along the entire distance.

"We spent several days at this upper village, taking some much needed rest, both for ourselves and for our dogs. I observed in their language a kind of patois or dialect differing only in the slightest degree from the Eskimo of Norton Sound and those at the mouth of the Yukon and the Kuskokwim. It may sound strange to hear that the Maneloots or Eskimo language is one of the most beautiful on earth. It more closely resembles ancient Greek than any other language. The roots and derivatives are nearly the same, and so it is also with the declensions and conjugations. The affixes and prefixes are also nearly identical. One of the fathers at Kotrefski has been at work three years compiling a grammar and a dictionary of the language, but it will require many years yet before it is completed.

"Our dogs had stood the trip of nearly 1,000 miles better than we had anticipated, and we were more than gratified to observe their good condition, and particularly the soundness of their feet, due, doubtless, to the care bestowed in shoeing them. When we had rested a few days at the village near the forks of the Selawik River, we began making preparations for our return. On the day of our departure every human being in the village crowded about us to know where we were going, and would we ever return again. They showed much sorrow at our leaving, some of the men accompanying us several miles down the river. We reached the beautiful Selawik Lake again without mishap, and made a detour of some forty or fifty miles around a small portion of its shores before proceeding down the lower river to the sound. This lower river is but a few miles in length, and resembles more a narrowed channel than a river.

"The lake being but a comparatively short distance removed from the ocean, is susceptible to the tides, and thus we have presented a body of water which, paradoxical as it may seem, is both fresh and salt—fresh at the upper end and salt at the lower. Another peculiar phenomenon noticeable about Lake Selawik is the evidence shown in the ice of the existence of subterranean warm springs. The lake freezes in the winter to a depth of from four to six feet, the presence of springs being readily detected by the appearance of the surface of the ice. There will be found the thin ice surrounding the hole where the warm water refuses to freeze for perhaps six feet in diameter, the ice growing more solid as the outside of the circle is reached. Upon the periphery of this circular freak of nature the water accumulates and freezes as it is forced through the opening by the influx of the tide until mounds of ice will be formed sometimes three feet high, hollowed at the center and, from a distance, resembling a saucer, which might have fallen from the table of some huge giant.

"Surrounding Lake Selawik there are probably twenty or thirty villages, some containing but a few families, while others have a population of 200 or 300. A person visiting these villages for the first time cannot fail to be impressed with the large number of huge bones lying around. Paleontologists would here find a perfect paradise, the remains of the extinct mastodon being visible everywhere. It is not uncommon to see the doorway of a hut ornamented by two immense tusks standing on the large end, one on each side of the opening, their curved points nearly touching overhead. They are frequently six and eight feet long and as many inches in diameter, weighing several hundred pounds. Investigation proved them to be in a wonderful state of preservation, considering the thousands and thousands of years that have elapsed since they were the ornament and pride of some huge male mastodon.

"The core of the tusk, sometimes three inches in diameter, was found to be perfectly hard and sound, and possessing the same luster when polished as does the ivory of commerce to-day when freshly taken from an animal. These tusks are sometimes sold to whalers, who find a ready market for them in San Francisco. Ribs and vertebræ are also very common, but these seem to possess little or no value beyond that of a curio. The Indians informed us that these remains were found in the frozen gravel banks after an avalanche or landslide had torn out a side of the bank and exposed a large quantity of the bones to view. They are also found occasionally in glacial deposits, and they made particular mention of finding one some years ago upon which a portion of the skin, covered with long, coarse, bristlelike hairs, and also some of the flesh was in such a state of preservation that the dogs would have eaten it had they not been driven away. Dr. Crew bought a small pair of tusks, which added not a little to the weight of our outfit. Upon arriving at civilization he would not have parted with his curios for any small sum of money.

"Upon reaching Kotzebue Sound we followed up the northeastern shore, intending to ascend the Kuwak River. Near its mouth we came upon some Indians, who informed us that there were no villages whatever on the Kuwak River. There is a peculiar feature of the outlet of this river, the like of which does not exist at any other place on earth. The stream has two separate and distinct mouths, not, however, of the nature of a delta. The river divides less than a quarter of a mile from the Sound, and standing stolidly between the two streams thus formed is a mountain we judged to be about 1,000 feet high, whose sides are so precipitous as to render ascent an impossibility. We did not enter the Kuwak as intended, but instead passed on around to the northern shore. From here we started across country to Port Clarence, a distance of nearly, if not quite, 400 miles. We had to travel entirely by compass, and during the entire distance did not encounter a human being. There was no fuel to be had on the way, and the only fire we had on the eight days it took to make the trip was that derived from a small oil stove upon which we boiled tea. We remained but a few days at the reindeer station, which seemed to be in a flourishing condition, and then turned our faces homeward once more.

"Before proceeding along the beach two miles we came across the carcass of a whale which had either been thrown on the shore during a storm or had floundered on the sand spit and was unable to get off. It was a huge monster, fully sixty-five feet long, and was frozen as hard as stone. We cut off some of the blubber with our axes, but the dogs would not eat it unless very hungry, on account of its being so oily. I also sent word back to Port Clarence, and the natives soon arrived and proceeded to cut the animal to pieces. But a day's travel below Port Clarence we entered Grantley Harbor. Following it to its head, we continued up the river and crossed the divide lying between it and Golovin Bay, the latter being an estuary of Norton's Sound.

"At the lower end of the bay we came upon a trader who would have excited pity in a heart of stone. His name was Ingalls, and he was formerly a whaler, but had deserted from his ship the year before. He had been given a few goods to sell by a Mr. Gibson, and was doing as well as could be expected until he met with the accident which will cripple him for life. He had been seal hunting, and upon his return had fallen into the icy water of the ocean. Not being able to change his clothes at once, and the weather being very bitter, he contracted a cold which developed into complete paralysis of the lower limbs. He had had no medical attendance whatever until our arrival. Dr. Crew applied such remedies as he had with him, including a small galvanic battery, but all to no avail. He was told his condition and advised to go to San Francisco at the earliest possible moment, which was the best we could do. He was a perfect type physically of manhood, which made his affliction all the harder to bear.

"The balance of our trip from Golovin Bay to St. Michael's was made without incident, and I arrived home at Kotrefski on April 24, just sixty days after my departure, having traveled between 1,900 and 2,000 miles, the bulk of which was over a country never before invaded by white men."—Alaska News.

EXPLORATION OF SERILAND.

A NEW view of the region inhabited by the fierce man-eating Seri Indians—the region that includes Tiburon Island, in the Gulf of California, and a considerable stretch of the adjacent Mexican coast on the east side of the Gulf—is given in the April number of the National Geographical Magazine, by W. J. McGee and Williard D. Johnson, who were members of the Bureau of American Ethnology expedition that, in the latter part of 1895, made an examination of the country and its people.

On reaching the frontier ranch of Señor Pascual Encinas, the now aged but always intrepid Seri fighter, a party that included some of Don Pascual's best men was organized, and a small boat was built for a ferry across the narrow strait that separates the island from the mainland, and then the work of surveying and mapping the entire region was begun. The extent of country to be explored was something like 100 miles square. In this region forty-seven elevated peaks were occupied for triangulation and sketching, and a much larger number for sketching only. As a result of this work a map has been produced. The district that includes Seriland may be likened unto a great roof slope stretching from a lofty comb in the Sierra Madre down into the Gulf, as into a huge eavestrough, but the slope is diversified, and the greatest variation from it is found where the Seris live. For, instead of sloping gently into the sea, the land rises suddenly at the water's edge into a coast range, Sierra Seri, an imposing assemblage of peaks, aretes, precipices and profound gorges, cutting the azure at fully 5,000 feet, though the width of the range from the strait to the desert is but ten miles.

Tiburon Island itself, the hiding place of the Indians, is but thirty miles long by twenty wide, and yet it is traversed north and south by several ranges, the most elevated of which is called Sierra Kunkaak, a range of Alpine ruggedness throughout most of its 4,000 feet of altitude. Even more impressive than the mountains is the desert on the mainland, over which the Seris roam stealthily, a broad waste of plazas and sand dunes. Toward its broad basin-shaped expanse the storm freshets flow from almost all directions, yet it is never full. It is partly barred from the Gulf and lined in its lower levels by a sheet of sediment charged with recent marine shells, which show that at no remote day it was an arm of the sea. Indeed, if it were to sink a few hundred feet, it would again be flooded. But were it to sink 3,000 feet, the Sierra Seri would still rise rugged and threatening as an archipelago far out in the new sea.

Most of the vapors that come sweeping in from the Pacific pass high over even the lofty crests of the Seri range, and are not condensed until they reach the Sierra Madre. So the whole land is a desert. In the height of the two rainy seasons, midwinter and midsummer, enough clouds do strike both the high coast range and that on Tiburon, so that streams are formed to rush down the slope in roaring torrents, but between the mountain-born Colorado River and the Sierra-fed Yaki, 500 miles apart, no river reaches the sea.

The local configuration appears to favor local winds (rising to nearly contiguous gales in December, 1895), and the unstable air brings forth fogs which feed the flora of coast and foothills, but little moisture ever reaches that broadest of the desert plains of western Sonora, the natural boundary of Seriland. So the aboriginal principality of Seriland is set apart, isolated, practically insulated, so far as life is concerned, by a natural barrier. A striking feature of the landscape is found in the abrupt transition from pinnacles and jagged cliffs to the smooth apronlike expanses of foot slope and plain. It is a picture that conveys irresistibly the impression that the mountains are buried to their ears in vast torrential deposits which fill the intervening valleys to profound depths, and the geologist is surprised and distrustful of observation when he finds that the intermontane expanses are simply planed rock strata with a scant veneer of torrent-spread alluvium.

And then there is the little strait between Tiburon and the mainland. Because of the fierce gales that sweep through it, the old Spanish explorers piously, and not profanely, named it El Infiernillo—the Little Hell. On coming to an examination of this desert region for characteristics that fit it for a human habitation, one is astonished to learn how few and meager these characteristics are.

"It is not too much to say," the explorers declare, "that there is no soil in Seriland, for the scant moisture and slow-growing plants do not produce humus, and the gray or ashen earth between the scattered plant colonies glares starkly in the sunlight, inflaming the eyes of the traveler as in snow blindness. In all the half dozen valleys, the hundred barrancas (earth cliffs), and the thousand storm-cut gorges there are probably less than a dozen nominally permanent and but two or three actually permanent sources of fresh water in the territory."

And yet, in spite of the ruggedness, in spite of the barrenness, and in spite of the utter aridity of this whole region, the fauna of Seriland includes the big horn and the bura (a large, sluggish deer) in the mountains, the antelope, peccary, and black tail deer on the plains, with the jack rabbit and coyote everywhere; the jaguar is reputed common, and the puma rare, the assemblage of large game animals being large enough to tempt the sportsman. The turkey is said to haunt the suguesas, and the California quail may be seen hourly, and small birds are surprisingly numerous, while hawks, eagles and burrowing owls abound. Ground squirrels and kangaroo rats are common. On some portions of the island the squirrels abound exceedingly, so that the land is laid out in hexagons by their surface trails, while each third or fifth footfall of the pedestrian stops half knee deep in burrows. The rattlesnake, scorpion, centipede and tarantula furnish spice for the fare of the traveler, while rainbow hued swifts and somber, slow moving lizards of alleged poisonous bite harbor numerously in the scattered plant colonies. There are ants galore, and myriads of black bugs that apparently fertilize the cacti, but mosquitoes, gnats, and other pernicious insects are apparently unknown.

The meager flora of Seriland is peculiar, the conspicuous forms being cacti, of which there are half a dozen kinds, including the water-bearing bisnaga, which undoubtedly often saves the Indians from perishing with thirst. There are occasional yuccas also, which in the flowering season furnish a pulpy food. Of trees the mesquit and catclan are the chief, a thorny hooked lot where found. The prevailing shrub is the creosote bush, and there are mimosas and other brambles endowed with foul flavors and odors. About the few permanent waters there are patches of bamboolike reeds, which are used by the Seri in making rafts, and sometimes for building houses. The dearth of water and the lack of soil produce a peculiarity in the flora—that is to say, it results from the dearth of water and strength of sun that the plants strive against the inorganic environment rather than against each other for continued existence, and are thereby brought into a curious co-operation, whereby nearly all plants gather into colonies for mutual support. Even a casual traveler cannot fail to note that the flora varies notably from place to place, and is generally gathered in close-set tufts or bunches, with broad, bare spaces between. The flora on island and mainland is essentially the same, and all the coasts are skirted with a zone of pulpy-leaved shrubs and bushes, apparently watered by fogs. More remarkable still is the assertion that there is a similar co-operation among animate organisms as well. The co-operation of the vegetation extends into the animate life of plain and mountain to the extent that all living things dwell together in singularly perfect harmony.

The permanent structures of the Seris are shingled over with the shells of the green turtles that abound on the coast and form the chief fare of the race. Fish and crustaceans swarm, edible crabs and oysters and superb lobsters await gathering, and clams sprinkle the coastwise flats.

"The seal creeps up on the rocks now and then, the shark scavenges the sea as the coyote the land, and the skeleton of a whale fully eighty feet long on the shores of Tiburon records a famous feast of the Seri when for weeks they found no need for hunting and fishing, and for months they gnawed gradually softening tendon and cartilage." The maritime fauna of the coasts is rich and varied.

Between the south end of Tiburon Island and the mainland is found a small island named Tassne by the Indians, that being also their name for pelican. It is less than a mile across in any direction, and a considerable part of it is composed of sand gathered by the swift tidal currents. The foundation of the island, however, is a pinnacled rock that rises 500 feet above the sea, the half submerged crest of a twinned peak, on which myriads of water fowl nest. The most numerous of the varieties is the pelican, and in the mythology of the Seri the Creator of the earth was the Ancient of Pelicans, and the first part that he formed out of the previously existing waste that was without form and void was this their Pelican Rock. But in spite of the Seri's reverence for the Ancient of Pelicans, he is very fond of pelican flesh, and uses its skin in making clothing. Every kind of water fowl from swan to snipe and from cormorant to curlew swarms about Tassne in winter.

The fierce holders of desert-bound Seriland have protected their inheritance from time immemorial, and since the time of Coronado have written their history in blood. They are as isolated in language, belief, custom, and sympathy as in habitat. They are dominated by a moral law, under which intermarriage with other peoples is capital crime, and under which they attain righteousness by slaying humans of alien blood with only greater avidity than beasts are slain, always save when deterred by fear. They are of a stature, strength and endurance befitting their hard lives.

The expedition prospected a little for gold. The prevailing rocks of the principal ranges are rather ancient lava sheets, with associated tuffs and breccias, while in several localities there are large areas of still more ancient granite, often slightly schistose and intersected with dikes and veins. It is the current belief in Sonora, a

belief based partly on the use of rare minerals as face paints among the Seri, that rich deposits of ores and precious metals exist in Seriland. Certain portions of the area examined appear worth prospecting, but no rich deposits were found, and most of the rocks examined were unpromising.

THE SERPENTS OF JAVA.

A CORRESPONDENT of the Illustrated Family Newspaper relates the following regarding the venomous snakes in Java:

The Imho sugar estates, in Java, comprise over 12,000 acres, about one-third of which is in cane. This is one of the most densely wooded parts of Java, and the bush is like a wall, impervious even to many wild animals, but snakes flourish, and there are no less than ten varieties that are deadly poisonous. Eight of the coolies employed on this estate have died inside of four months from snake bites. The chain viper is most dreaded, as it will not get out of one's way, and when trodden on by the barefooted natives strikes fatally. Twelve miles away is the ruined city of Choru, a wilderness of temples built of stone, cut in designs as fine as lacework. On the north side of these buildings are long arched passages, and here wild animals resort to get out of the intolerable heat. Leading from these avenues are hundreds of small chambers having no windows. In these lurk more snakes than can be found anywhere else in the island.

It is not surprising that the eastern nations look upon Englishmen as lunatics; they do so many foolhardy things from no apparent motives save to risk their lives. Two years ago an English naval lieutenant was here visiting a neighboring planter, and his peculiar craze was making a collection of Javan reptiles. His only attendant was an English sailor lad, about sixteen, and these two, against all warning, went roaming around the forests without a guide. In Choru, the ruined city, the lieutenant found a rich harvest, and killed a magnificent black jaguar, but an adventure with a snake ended his sport. One day he and the boy were under one of the long archways of the big temple, and, looking through the doorway of one of the dark chambers, saw something yellow in the far corner. Without a moment's thought, he entered and gave the mass a punch with his cane. A tremendous hiss that fairly shook the walls was followed by an assault swift as the leap of a tiger, and the man found himself seized by a huge Dari snake, the most aggressive and dangerous of our constrictors. His left shoulder was crushed in the brute's teeth, and quick as a flash a coil was around his body, and he felt the steel-like compression.

But the grit of the boy saved his master's life. He had a heavy, sharp wood knife, and he struck the reptile two heavy blows just back of the head, the most vulnerable part of its body, because the thinnest. Its backbone was divided. The coil relaxed, but the powerful tail lashed out, breaking the boy's leg. It was two hours before they were found and brought up in a cart. The lieutenant's left shoulder was crushed beyond surgery, and the arm was useless. Both master and boy recovered after a spell of fever. I saw the snake, a hideous object, black and yellow and fifteen feet long. Such a brute would crush a horse.

Gunning one day near the Wasli River, in the interior of the island, I watched a number of wild hogs coming to the water to drink. Suddenly the head of a snake rose above the grass and a hog squealed. A python had seized a full grown one, easily three feet high at the shoulder, and thrown two coils around the body. Under the tremendous pressure the hog seemed to lengthen, and when the snake uncoiled I saw only a strip of meat, nothing distinguishable but the head. I shot the snake. It was twelve feet long and over seven inches through, and yet its coils had crushed the bones of its prey like chips. There is no doubt that hidden away in vast swamps of the interior are many anacondas of enormous size. Parties have been made up to hunt them, but the malarious climate drives them back. In the museum at Batavia is the skin of a serpent that must have been fifty feet long when living. Such a brute would kill a man as easily as it would a rabbit.

A TEAM OF ZEBRAS.

UNTIL lately the zebra, that species of the horse found in Africa, and nearly related to the donkey, has been considered untamable, and many stories have been told of the unmanageable wildness with which he resisted all attempts to employ him in the service of man. But patience and perseverance have, in the meantime, tamed even these stubborn creatures, and once in a while a zebra is seen in Cape Colony performing the duties of a beast of burden, and, of course, the attempt to conquer him was repeated in England. It will be understood that many of these animals are utterly unfitted for such work, and have to be sent away as useless, and therefore it must have cost Walter Rothschild, of London, a large sum before he and his head man succeeded in getting a good team of zebras. Now, besides being the owner of a remarkable team, he has the credit of having enriched the street pictures of London by the addition of something entirely new. The zebras accustomed themselves to the noises of the

TEAM OF ZEBRAS BELONGING TO BARON WALTER ROTHSCHILD, OF LONDON.—FROM A PHOTOGRAPH BY H. S. MEWMAN.

great city in an extraordinarily short time, considering that, during their journey across the country, they became alarmed at any sudden noise, and a strong hand was needed to control them.—Ueber Land und Meer.

MUNICIPAL PLAYGROUNDS.

DURING the last twenty-five years the movement of population has been from the country to the city, and the rapidity with which American and European cities have increased in size during this period is marvelous. This movement has been even greater in Europe than it is in America, although we are apt to regard the growth of some of our Western cities as unparalleled; and in Europe, at least, the effort to improve the condition of urban populations has kept pace with their growth. The last ten or fifteen years have witnessed substantial reforms, too, in the management of American cities, and if these efforts toward reform have not always been successful, their failure can be largely traced to political conditions, rather than to want of zeal and intelligence in the reformers.

In modern municipal equipment much provision is made for the instruction and amusement of children, and in most modernized European cities large sums of money have been expended in procuring open spaces for them in districts of congested population. Mr. Albert Shaw, in his Municipal Government in Great Britain, in describing the methods and results of modern London management, points out as remarkable "the manner in which the committee on parks has made provision for the athletic culture of young Londoners of both sexes, and for their natural and healthful devotion to outdoor sports. Cricket grounds and football grounds, literally by the thousand, have been laid out, besides many hundreds of tennis courts, and various golf and hocky grounds. The council committee has not merely provided these opportunities for recreation, but it has gone so far as sedulously to supervise the use of the cricket grounds and other playgrounds, to the end that the largest possible number of young people may get the best attainable results of pleasure and physical development from their use. The council has imitated the Continental cities in making provision for music in the parks, and its numerous subsidized bands are giving more than a thousand open air concerts each season. It has succeeded in making the parks so attractive that several million persons each year are now deriving pleasure either from participation in the games, attendance at the concerts or in other similar ways. The preservation of several very large outlying tracts of wooded park land, together with the opening up of numerous larger and smaller public pleasure grounds in every district of the huge metropolis, has now made it certain that the growth of London can never shut off the children of future generations from access to the grass and trees and open air sports;" and from his work on the Municipal Governments of Continental Europe, it may be learned that in modern Paris and Berlin, Vienna, Hamburg and many other German cities, abundant provision has been made for the recreation and refreshment of all classes of people in numerous and carefully located small parks, squares, playgrounds and other open spaces.

In this country, where much has been done in the last forty years in providing our cities with large rural parks, the establishment of playgrounds in connection with urban schoolhouses, and small parks or playgrounds in congested districts, has been singularly neglected. In this city, however, two admirable small parks have recently been opened in the most crowded parts of the East Side, the land for others has been taken, and New York has legislative authority to expend a million dollars a year for this purpose. Two completed East Side parks at Mulberry Bend and Corlears Hook are, however, small parks and not true playgrounds—real oases in a veritable desert of squalor, with fresh green grass and trees and flowering shrubs. Green grass is always beautiful, and in the midst of a tenement house district it is doubly refreshing; but children cannot play on turf without destroying it, and if these parks are to be kept fresh and green, the edict to keep off the grass must be sternly enforced; and it is a question worth the attention, perhaps, of municipal reformers whether open spaces in such districts would not better supply the public needs if a large part of their surface was covered with gravel or asphalt on which children could play freely, the grass and trees being confined to a narrow marginal border.

What has already been done in this city in providing open spaces is, of course, still very inadequate, but it is more than has been accomplished in any other large American city. Brooklyn has a noble playground of forty acres of beautiful level turf beyond Prospect Park, but it is still remote from the centers of greatest population and little has been done to secure open spaces in the heart of the city or to provide for them on its rapidly advancing borders. This is true, too, of Philadelphia, Chicago, Baltimore, St. Louis and San Francisco. These cities are now admirably provided with large parks and with grass covered squares, but no adequate provision has been made in any of them for convenient playgrounds for the children of the poor. Boston and its suburbs, judging by the ratio of park area to population, is the best parked community in the world, but in the great park system of the New England capital little attention has been paid to the question of playgrounds. The city itself has spent in

a comparatively short time $12,000,000 on the city parks. It has one admirable large playground in Franklin Field, situated, however, in what is now a remote and comparatively inaccessible district, beyond walking distance for a majority of the school children of the city, and between the Common, now too small and too much used to serve as a playground, and Franklin Park, a distance of about seven miles through the parks, no provision whatever has been made for playgrounds. This serious objection to the Boston park system may, however, still be remedied, and Mayor Quincy, who is alive to the importance of this subject, will, it is to be hoped, make his administration memorable by inaugurating a general system of conveniently located playgrounds and open spaces. The little town of Brookline, which is adjacent to Boston on the southwest, has already set a good example by placing $100,000 in the hands of its park commission to secure land in the less thickly populated parts of the town for the benefit of future generations of children, the more densely populated districts being already provided with three large and excellent playgrounds adjacent to some of the principal schoolhouses in the town.

Other cities and towns may well follow this example and secure now, while land is comparatively cheap, an adequate provision of open spaces for the future. All our cities, large and small, will increase rapidly in population, and land within their borders, or in their immediate neighborhood, adapted to the purposes of parks and playgrounds, will never be cheaper than it is now. A wise policy will make such provision in advance of the actual necessities of the community, and in laying out the new districts of all cities land should be liberally secured for these purposes.

The growth of cities at the expense of the rural population will make the supply of country bred men and women, who in the past have been the mainstay of the nation, smaller and more difficult to obtain; and the men and, what is even more important, the mothers of the men who are going to carry on the American experiment of self-government will be city boys and girls. Too much, therefore, cannot be done to make them healthy, clean and well instructed, and unless they are supplied with fresh air and with opportunities to play in freedom the games which belong to their age, their chances of becoming useful citizens are not promising. —Garden and Forest.

THE MONOLITHIC CHURCHES OF LALIBELA (ABYSSINIA).

AMONG the numerous curiosities found in Abyssinia, stand in the first rank its monolithic churches. The number of these is large, since, according to Mr. A. Raffray, who visited some of them in 1881, there are nearly two hundred which are still devoted to worship. The one nearest the coast is situated upon the eastern frontiers of Haramat, a little to the north of the town of Agula. These singular edifices are of more or less recent date, but all of them, as regards style, correspond to the churches of the town of Lalibela, the capital of the province of Lasta. This town is situated out of the line of the routes usually taken by either the Europeans or the Abyssinian traders, and this is explained by the fact that it is an exclusively religious town, with a population of but 3,000 souls, and that, in order to reach it, it is necessary to traverse a very broken country. So Mr. Raffray was the first European of modern times to enter it.

The churches that it contains, says he, are ten in number, and yet the traveler on reaching Lalibela is greatly astonished to perceive, amid the huts that constitute every Abyssinian town, no building worthy of attention. But, if he traverses the town, he soon meets with vast open cuttings that are long and sinuous and that lead him to the foot of these churches. It is, in fact, because these buildings form an integral part of Mount Abouna Yousef, against the southern declivity of which stands Lalibela. The architect has caused the excavation of open quarries in the midst of which he has left a block which is no longer connected with the mountain except by its base, or sometimes by its sides. In this case, a semicircular tunnel permits of making the tour of the edifice (as in the Abba Libanos church). The block was afterward worked externally in such a way as to form walls and porticoes, even with colonnades. Finally, the interior was hollowed out in such a way as to leave columns and lateral and transverse semicircular arches (Fig. 3), for supporting the ceiling, and, in the last place, windows were formed for the admission of light and air.

These edifices are, therefore, genuine monoliths. They exhibit, moreover, very different arrangements of detail, and are divisible into three groups, one of five churches, one of four and one of a single church.

The common orientation is easterly, and all the architectonic characters correspond to the Byzantine style. No inscriptions are remarked in them. In the first two groups the churches are surrounded by courts, and open cuttings or vaulted passages form a communication

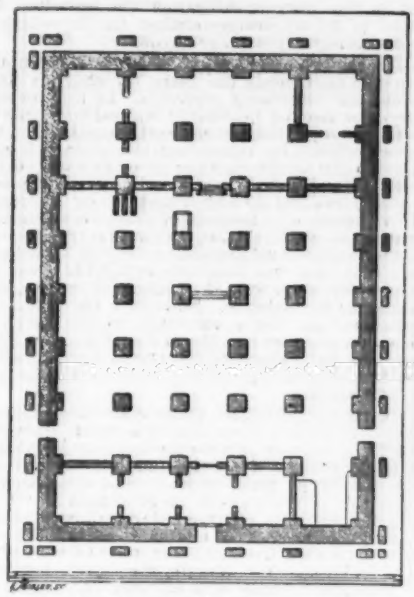


FIG. 1.—PLAN OF THE MONOLITHIC CHURCH OF MEDANI-ALLEMM.

between them. The rock out of which they are carved is a sort of coarse grained red sandstone, which is quite friable. According to the traces still observable upon the walls, the only instrument employed must have been the pick, for there is nowhere found that polish that would have been given by the chisel.

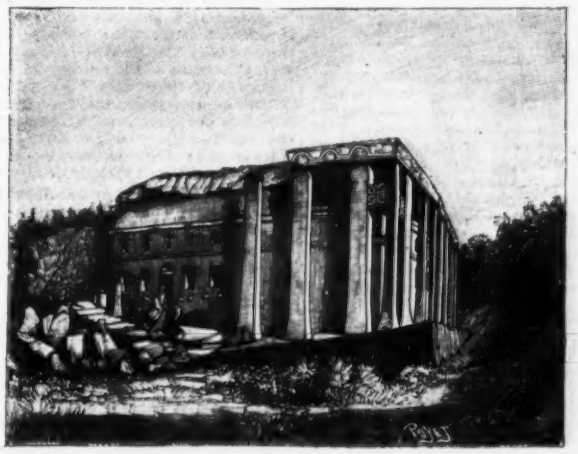


FIG. 2.—EXTERNAL VIEW OF THE MONOLITHIC CHURCH OF MEDANI-ALLEMM.

Our figures, which are from drawings made by Mr. Raffray, represent the church of Medani-Allemm (the Saviour of the World) and that of Hammanuel (Emmanuel), which are the principal ones of the first and second groups.

That of Medani-Allemm (Figs. 2 and 3), which is of rectangular form, is surrounded with a colonnade which supports a projection of the upper terrace. The latter is not absolutely flat, but has the form of a roof shelving on both sides. In the interior (Figs. 1 and 3) the structure is divided into five naves and eight aisles formed by rectangular columns. The latter are ornamented with capitals and connected with each other by semicircular arches that inclose square and flat ceilings. At the extremity of each aisle there is a transept whose lower part comprises a cross with unequal arms, and the upper part ten small circular apertures surmounted by a group of others much smaller and in the form of stars and Greek crosses. These latter were originally closed with colored glass, a few vestiges of which still remain. The vestibule and choir are inclosed by transverse walls. The excavation is 140 ft. in length, 125 in width and 33 in depth. The external dimensions of the church measured at the colonnade are: length, 110 ft., and width, 77 ft. Finally, the internal dimensions are: length, 85 ft., and width, 64 ft. The greatest thickness of the walls is 6½ ft. Internally, this church is in a perfect state of preservation, but, externally, the colonnade that surrounds it was too fragile to resist the injuries of time and man, and so it is intact only on the eastern side.

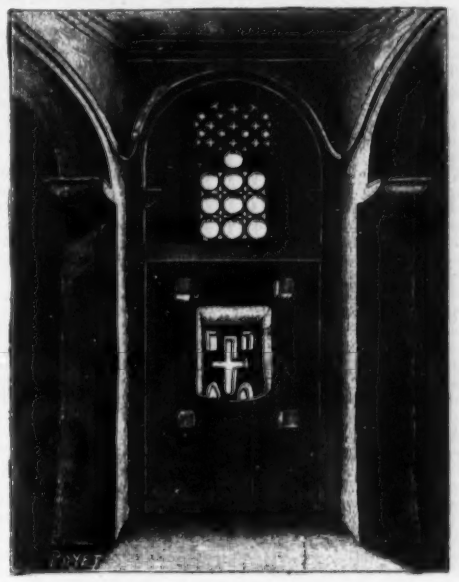


FIG. 3.—INTERNAL VIEW.

The church of Hammanuel (Fig. 4) is the finest of the second group. It, as well as the court that surrounds it, is of rectangular form. The court is 98 ft. in length, 78 in width and 38 in depth. The church is 58 ft. in length and 38 in width. In the court there is a small baptistery in the form of a Greek cross. The edifice stands upon a sort of subbasement in steps. The

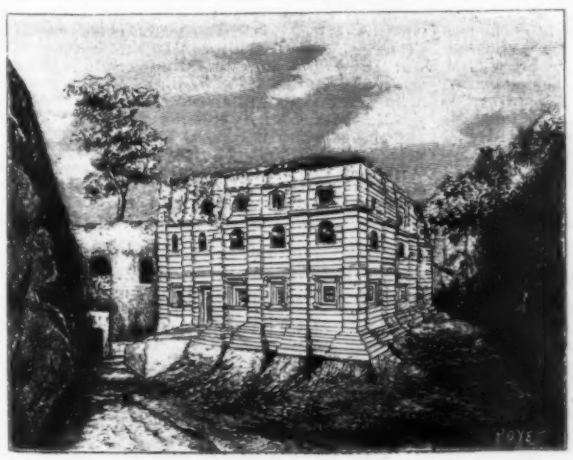


FIG. 4.—MONOLITHIC CHURCH OF HAMMANUEL.

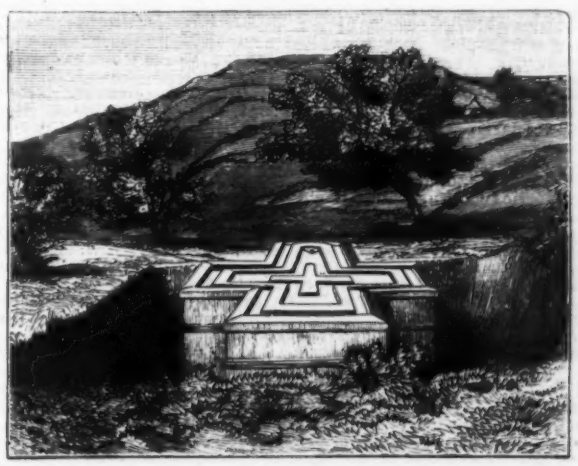


FIG. 5.—TOP OF THE MONOLITHIC CHURCH OF GHORGHIS.

large facades show three stories containing fifteen openings, one of which is a door. The windows of the ground floor are cross shaped, those of the first story are arched and provided with capitals, and those of the second are square. Between each window there is a colonnade and several flat mouldings or flat bands.

In Fig. 5 we give a view of the top of the Ghorghis (George) church, which is in the form of a Greek cross and in size nearly equal to the preceding. This figure gives the aspect presented, at the level of the ground, by the monoliths that we have just described. The other churches of Lalibela are generally of smaller size, although they have necessitated important work of excavation.

These curious edifices were all constructed under the reign of Negous Lalibela, to whom Assyrian tradition assigns one of the greatest of mystic roles, and who lived, it is thought, in the twelfth century of our era. He called from Alexandria an Egyptian named Sidi-Meskal, who, with 500 laborers, came to carry out this remarkable enterprise, and whose tomb still exists in the church of Medani-Allemm. According to a manuscript in the Gheza language, consulted by Mr. Raffray and preserved in the same church, this work, which is so colossal, considering the cubage of the internal and external excavations of the churches, as well as the dearth of tools placed at the disposal of the laborers, took but twenty-three years (or twenty-eight, according to oral tradition) for its completion.

As we have above said, the state of preservation of the edifices is generally perfect in the interior, but the exterior, on the contrary, has suffered from the inclemencies of the weather and injuries done by man, especially at the epoch of the Mussulman invasion, in which Sultan Mohammed Gragne, in order to wipe out every trace of Christianity in Abyssinia, buried all the churches under rubbish. They remained in this state for many years, and were not dug out until after the expulsion of the invaders by the Abyssinians with the aid of the Portuguese. They were then devoted to worship again.

The churches of Lalibela served as models for all those that were established in the other parts of Abyssinia; but these latter are merely more or less imperfect copies of their predecessors, and in all cases much more recent. So they offer less interest to the traveler, and, at the same time, they do not, like the one just described, enjoy the great veneration that attaches to the mystic remembrances of Negous Lalibela.—La Nature.

THE UTILITY OF THE VACUUM.

MAKING money out of nothing. The notion is attractive. Many millions of dollars in this country are invested in patents depending upon a vacuum, which is less than what most people call nothing, says the St. Louis Globe-Democrat. These inventions cover a great variety of industries, such as preserving foods, tanning, fermenting, bleaching, hardening stone, and making woods imperishable. Some of them actually relate to the keeping of corpses and the manufacture of mortuary memorials. The history of the vacuum in the United States Patent Office is an interesting one, dating back to 1833, in which year George H. Richards took out exclusive rights in a process for preparing leather from various substances by evaporation in vacuo at a temperature below 212°, the object being to avoid injuring the product by too great heat. This method is applied in obtaining flavors for sirups dispensed at soda water fountains. It also serves in making extracts from malt and hops and from coffee. The fact is well known that firms engaged in the business of roasting coffee for market commonly deprive the beans of their volatile flavoring essence and sell the latter separately. An honest coffee roaster returns this essence to the beans. Much of it passes off during the ordinary cooking process, and thus it happens that at times the streets in the neighborhood of a grocery store are fragrant with the odor of coffee. It is agreeable to the nostrils, but very wasteful. A properly constructed roasting machine saves and condenses the precious vapor.

There was once a firm of bakers in London that hit upon a very novel expedient. The process of bread making depends upon a fermentation which develops alcohol. This alcohol passes off in vapor from the ovens under ordinary circumstances. The concern in question devised a method by which it could be saved, the vapor being passed into a condenser. Unfortunately, rival bakers took a notion to advertise as widely as possible that their bread was sold "with all the gin in it." As a result the enterprising establishment lost its trade and was ruined. To assist the process of fermentation methods have been contrived for partly baking bread in vacuo. Bakers, by the way, use great quantities of egg meats dried in vacuum pans. The eggs are broken into the pans, the whites and yelks being separated. They are then evaporated to absolute dryness, after which they are scraped from the pans and granulated by grinding. The product looks very much like sawdust; it is comparatively cheap and will keep good for many months, taking the place of fresh eggs when the latter are scarce and dear. It is prepared on a considerable scale in St. Louis. A similar process is employed in the manufacture of so-called "egg albumen," which is said to be composed largely of the whites of the eggs of wild fowl. It looks like a fine quality of glue, and costs fifty-five cents a pound, being used by bakers and for glazing prints.

Several processes have been patented for preserving eggs in their shells by means of the vacuum. One method is to place them in a chamber, which is then exhausted of air. The air, containing the germ of decomposition, is thus drawn out of the eggs, and carbonic acid gas is forced into the receiver to take the place of it. The eggs are taken out and covered with a varnish to prevent the air getting into them again. A variation of this idea is to introduce into the receiver melted paraffine, which fills the pores of the shells.

By far the most useful application of the vacuum has been for the preservation of wood. Scores of patents in this line have been granted. So far back as the year 1837 August Gotthilff, of New York, secured exclusive rights in a process for "protecting timber from destruction by worms, dry rot, and other causes of spontaneous decay." His idea was to exhaust the air from the wood and fill up the pores with coal tar and turpentine. In this direction a great industry has since grown up. At Wilmington, N. C., piles and railway timbers for the entire South are impregnated with preservative substances. Railway ties are commonly treated in this manner, while metallic solutions are employed to defend bridges against the depredations of the devouring shipworm or teredo.

Wood is artificially colored by using the vacuum to withdraw its fluid juices, the place of which is filled with solutions containing pigments. In this manner ordinary pine may be beautifully stained and made to serve as a substitute for rare and costly wood. Lumber is seasoned offhand by exhausting the air from it, and then forcing dry air through the pores to carry off the moisture. Wood is hardened for all sorts of purposes, from bridge making to wagon making, by a process called "vulcanizing." Rubber, of course, is vulcanized by treating it with sulphur, being thus transformed from a substance soft and flexible to one that is hard and brittle. This idea was long ago applied to wood by saturating the latter with a solution of rubber, and then applying the sulphur. Nowadays the rubber is not used, the wood being subjected to the action of hot air under pressure in a closed chamber. The pressure prevents the escape of the sap and gums, while the heat has a hardening effect. This is what is now termed vulcanizing.

The records in the Patent Office would seem to show that people in these days are almost as much interested in preserving corpses as were the ancient Egyptians. Inventions in this line are multitudinous. One of them describes a coffin of glass, which is to be exhausted of air, a gas that is destructive of all animal life being substituted. For this purpose sulphur dioxide or carbonic acid gas will serve. A method of embalming consists in withdrawing the fluid contents of the body by means of an air pump as a preliminary to forcing antiseptics into the arteries and cavities. An ingenious Yankee has devised a scheme that is calculated to be a consolation to surviving relatives. The ashes of the cremated defunct are to be reverently collected and compressed into a suitable memorial likeness, bust or statuette, at once ornamental and sacred. The patentee suggests an air pump shall be employed to facilitate the drying of the ashes.

There are numerous patents for preserving foods with the aid of the vacuum. One idea is to extract the air contained in the meat, fish and fruit, which are to be impregnated thereupon with a solution of gelatine. This being accomplished, the meat or what not is to be taken out and dipped into a solution of gelatine, sugar and gum, so as to give it a coating on the outside. Thus it will keep for an indefinite period. A young woman of Philadelphia, Isabel M. Mitchell, proposes that food of all sorts shall be kept good by means of ozone gas. Her machine manufactures the ozone, which is permitted to fill the exhaust chamber after the air has been withdrawn. She says that articles thus treated may be subsequently exposed to the atmosphere without risk of decay.

Vacuum processes are to-day largely and successfully employed in the salting and pickling of meats and vegetables. They are shut up in chambers from which the air is withdrawn, and brine then forced in under pressure. The meat is sometimes stuck full of tubular perforated skewers, to permit the gases to escape and to admit the brine to all parts of the substance treated. Another method adopted is to withdraw the brine with the air pump and force smoke into the meat, which is thus smoked as well as salted. On this idea there is an improvement, which consists in utilizing a smoked brine. This is prepared by withdrawing the air from a tank containing the brine and forcing the smoke into it under pressure. Then the smoked brine is applied to the meat.

Methods are used on a considerable commercial scale for preserving meats and vegetables by withdrawing the air from them and substituting various gases, such as oxygen, nitrogen, hydrogen, carbonic acid gas, and even illuminating gas. Argon has not been suggested for the purpose as yet, but before long it will be, doubtless. In 1853 Henry Hunt took out the first patent for employing the vacuum in canning fruit products, such as would suffer injury from heating. His idea was to exhaust the air from the cans in order that no germs of putrefaction might remain. A singular adaptation of the same notion is credited to Nat Raymer, of New Sterling, N. C., who has invented a fruit jar stopper with a short metal tube attached to it. The housewife, when she has closed a filled jar of fruit with such a stopper, has only to suck the tube and pinch it with pliers, fusing the end with a red hot iron, to make it airtight.

Eggs are canned by the vacuum process, being heated somewhat to preserve them, but the temperature to which they are raised cannot be high, for the white hardens at 140°. Oysters are put in cans with salt and carbonic acid gas, the air being withdrawn by a pump. Milk is condensed by a vacuum process, because it would be spoiled by raising it to 212°. The same idea applies to sugar, which is refined in vacuum pans. Thus the molasses is evaporated to crystallization much below 212°. Boiling would invert it, as the chemists say, making it like glucose. Glucose, by the way, is distinguished as the non-crystallizable sugar, but recently a process has been found by which it is crystallized, resembling brown sugar. Butchers and meat packers still adhere to the old-time methods of slaughtering cattle, though John Gamgee has patented a much better plan. He proposes that the animals shall be caused to inhale carbonic acid gas, after which they may be bled and dressed in the usual way. The flesh of beasts thus treated, it is alleged, retains its fresh appearance longer than meat that is killed in the ordinary way. Another inventor has a process for hardening artificial stone by exhausting the material of the latter of air before impregnating the sand and silicate of soda with a solution of lime. Yet another genius has originated a plan for preventing barrels from leaking. He exhausts the air from the staves and fills the pores with melted paraffine, thus making the wood impervious to fluids. The variety of purposes to which the vacuum is applied is well nigh endless. It is used to make candied lemon peel, to disinfect baled rags, in the preparation of dried potatoes, in making pickles, for bottling beer, for cleansing fabrics, and for rendering explosives safe against spontaneous combustion.

SELECTED FORMULÆ.

To Remove the Odor of Iodoform.—It is said that the odor of iodoform may be completely removed from mortars, spatulas and other utensils used in compounding iodoform combinations, by simply adding a little turpentine to the water used in washing, with soap, and rinsing well. This might be found useful in removing the odor of iodoform from the hands.

Bicycle Lamp Oil.—The following is given as a receipt for a fine lamp oil: Fill a pint bottle with two-thirds of the best lard oil and one-third of headlight oil, to which add a piece of gum camphor about the size of an egg. The camphor is supposed to cause the oil to give a very white light, and it is said that the lamp will not go out easily.

Cement for Leather.—Take of

Strong glue	50 parts.
Water, sufficient quantity.	
Turpentine	2 "
Starch paste	100 "

Dissolve the glue over the fire in the water; add the turps, stir up well, and mix with the starch paste while hot.

Dressing for Kid Shoes.—

Yellow ceresin	25 parts
Oil of turpentine	25 "
Castor oil	25 "
Linseed oil	250 "
Wood tar	7 "

Dissolve the ceresin and tar in the oil of turpentine, mix the heavy oils, pour the liquids together and stir until homogeneous. Add mirbane oil sufficient to disguise the turpentine odor.—Nat. Druggist.

Borax for Brazing.—Probably for some kinds of work borax will never be improved upon for a flux, but for some other varieties of brazing borax does not completely fill the bill, as, for example, when brazing work which must be filed and cannot be ground. Then the borax will leave a very hard skin, which destroys many a file before it is fully removed. For this kind of work some mechanics like to use boracic acid, putting it on with a brush or swab. The hard skin is thinner and comes off easier when the acid solution is used, but the difference lies mostly in the fact that not so much of the flux is used when the solution is employed. The usual way is to pound up a lot of lump borax in a lead melter's ladle or the hollow of a blacksmith's sow. Some of this usually very coarse powder is placed on the work with a flat bit of iron. Too much borax for the purpose is necessarily used in this manner, and the excess goes to make up the hard skin which dulls the files. When the acid is used, the same effect is secured as when the solid borax is applied, but not one-tenth the amount is used, and that is applied just where it is needed. If for any reason the foreman insists upon borax being used, make that official procure a coffee mill and have all the borax ground very fine. Then a little of the dust powder may be rubbed or dusted on where the joint is to be made, and the braze may be made without having a lot of oxide and slag piled up around the work.

Bicycle Oil.—An excellent lubricating and burning oil is a mixture of equal parts of sperm oil and vaseline oil, or one part of the first and two of the second, if a lot is wanted for the money. In the following form the oil may be called

CYCLISTS' UNIVERSAL OIL.

Camphorated oil	1 ounce
Sperm oil	3 "
Vaseline oil	4 "

Mix.

This is "an oil for lamps, for lubricating bearings, and as an application for bruises or sprains. In the last case, if the skin is unbroken, pour some of the oil upon the palm of the hand and rub it well on the spot for five minutes, kneading and working the muscle freely. If the skin is broken, smear the spot with the oil and tie a clean handkerchief round it." It is desirable to color the oil slightly with alkanet.—Chemist and Druggist Diary.

Black Polish on Steel Needles.—Mr. Herman Nobis, of Berlin, covers steel needles with a black coating which takes a polish in the following way, says the Electrical Age: The needles are cleaned of grease and any oxide and first dipped into a bronze bath. Twenty grammes of sulphate of copper are dissolved in hot water and filtered; 15 grammes of stannous chloride and 20 of hydrochloric acid are then added, and the solution is diluted to one liter. The liquid becomes turbid and a whitish sediment forms; in this state it is ready for use and can be kept for several days. The needle remains only ten seconds in this liquid, is then rinsed with water and put for two or three minutes into another solution containing 1·5 kilogrammes of sodium hyposulphite, 75 grammes of hydrochloric acid and 1 kilogramme of water. The hypo salt is dissolved warm, filtered through cloth and mixed with the acid; the liquid becomes yellow and turbid and is, after a few minutes, poured through a fine wire sieve. The solution remains good for two hours and can be renewed by adding fresh hydrochloric acid, after which it has to be refiltered. The needles are finally washed in water and dried. The process is patented.

A Solution for Stopping Falling of the Hair.—

Hydrochlorate of quinine	1 drachm
Tannic acid	2 "
Alcohol, 70 per cent	1½ pints
Tincture of cantharides	2½ drachms
Pure glycerine	1½ ounces
Cologne water	10 drachms
Vanillin	2 grains
Pulverized sandalwood	1 drachm

This mixture, after being well mixed and shaken, is allowed to stand for four days, and is then filtered. It is rubbed into the scalp daily for the purpose named.—Revue de Therapeutique Medico-Chirurgical.

ENGINEERING NOTES.

During the six months ending June 30, 1896, two passengers were killed on the railways of the United Kingdom, and fifty-four were injured from accidents to trains, rolling stock, permanent way, etc., as compared with none killed and 121 injured in the corresponding period of 1895, and thirty-three passengers were killed and 550 injured by accidents from other causes, as compared with thirty-three killed and 306 injured. Of servants of companies and contractors, 203 were killed and 1,848 injured, as compared with 221 and 1,851 injured in the corresponding period of 1895.

A new system of ventilation has been put in use in the United States Senate chamber at Washington, designed by Prof. S. H. Woodridge, of the Massachusetts Institute of Technology. The benches in the visitors' gallery have been removed and theater chairs, with folding seats, substituted. The legs of the chairs are hollow, with perforated sides, and the fresh air for ventilation is distributed through the perforations. The air is furnished by a fan driven by an electric motor, and in warm weather it is first cooled to 60° by an ammonia refrigerating apparatus, depositing its moisture, and is then dried and heated to 70° or 75° by passing over hot water pipes. In cold weather the refrigerating apparatus is omitted and the air is warmed to the desired temperature.

A gas engine has been devised by M. Rey, of the French Polytechnic School, in which the slide valve, the single cylinder and a four cycle have been retained, but in which the order of events in the four cycle is the following: (1) Introduction of pure air (instead of gas and air mixture); (2) instead of compression simply we have, first, expulsion of a part of the air just introduced, secondly, introduction of the gas, and, thirdly, compression of the mixture; (3) and (4) explosion and escape, as in the ordinary four cycle. By this arrangement the same quality of gas may be made to work in a much larger cylinder, so that the energy of the explosion is more effectively turned to account; and it is reported that with this engine the consumption of gas is reduced to 12½ cubic feet per horse power.—Gas World.

A steam carriage or omnibus, built by M. Scotte of Epernay, France, is now in service between Picauville and the nearest railway station. The motor car consists of a front compartment for the engine and a back compartment for 14 passengers. The trail car will seat 24 passengers. The 16 horse power engine is of the vertical compound type. The boiler is vertical, and carries a pressure of 50 lb. per sq. in. The power is transmitted to the rear wheels, and the forward wheels are employed for steering, being pivoted around a vertical axis by means of a wheel directed by the engineman. The coal or coke for fuel is carried forward, and the bunkers will admit of about 450 lb., or sufficient fuel to serve for four hours of travel; 150 gallons of water are carried in the tanks situated under the seats and under the floor. The dimensions of the motor car are 17 ft. in length and 6 ft. wide. Its weight is 7,700 lb., without passengers. It will turn a circle of 12 ft. diameter.

Miners are becoming interested in a new mining explosive described by Prof. F. Kleinpeter, of Vienna, which is being introduced in Austria. The name given to it is Dahrnenite A, and its strength is said to be 33 per cent. greater than the best gelatine dynamite, and, in consequence of the large volume of gas which it produces—being approximately double that yielded by dynamite—it has a wedging rather than a pulverizing action, resulting in a materially increased fall of lump coal. Other advantages mentioned are that it can be compressed without losing any of the explosive force, and in this state is claimed even to exceed dynamite. A weaker detonator is required to bring it to explosion than is demanded for any other known safety explosive, and it is better able to withstand the effects of storage, and no decomposition can take place when the packing is proper. Indeed, such is the safety with which it may be handled that the German railways allow it to be carried on any train.

A dustproof car has been devised by Mr. E. H. R. Green, general manager of the Texas Midland Railroad, and a car fitted with the necessary appliances has been put in service, says the Engineering News. According to published descriptions, there are water-drenched ventilators located in the walls of the car between the windows, and water pipes produce a shower of artificial rain in each ventilator. The water is carried under pressure through the pipes to drench each of the wire fabric air filters in the ventilators. The power is derived from the axle, and is transmitted through the medium of flexible coiled wire bands. The same water is forced through the pipes and ventilators repeatedly, being used over and over again all day. The pumping apparatus is located out of sight under the floor. When the passenger wants a breeze, he turns a knob which throws open the air deflector on the outside. This catches the breeze produced by the forward motion of the car, and throws it through the water-drenched air filter into the car. This breeze may be increased, diminished or shut off entirely at the pleasure of the passenger.

The Automobile Club, of France, has just issued the programme of a competition which is likely to be of far more practical utility than the Paris-Marseilles motor carriage race. The competition, which is to begin on July 1, 1897, and will be open to all motor cars, whether French or foreign, is to be organized with a view to the creation of regular motor car services for the conveyance of passengers in towns, the conveyance of passengers and luggage from railway stations to outlying localities, and for the delivery of goods. The motor cars to be admitted to this competition must be capable of carrying at least ten passengers, with thirty kilogrammes of luggage each. The motor cars for the delivery of goods must be able to carry at least one ton. The competition will last six days, during which each motor car will have to accomplish twice the following programme: A journey of forty kilometers, with a stoppage every kilometer, a journey of fifty kilometers, with a stoppage every five kilometers, and a journey of sixty kilometers, with a stoppage every ten kilometers. Some of the stopping places will be purposely fixed on steep hills and at other inconvenient spots.

ELECTRICAL NOTES.

Electric locomotives will be tried on the lines running from St. Petersburg to Moscow and Warsaw, Russia. The experiment is said to be in charge of the Ministry of Ways and Communications.

Electric lighting for signals, stations, etc., is said to be in contemplation by the New York, New Haven & Hartford Railroad. The plan, as reported, is to have power plants at intervals, furnishing light for stations, yards, signal towers and signals.

A foreign exchange states that telegraphy by electric search light is established and regularly worked on fine nights between Port Louis and Mahebourg (Mauritius), a distance of twenty miles. A peculiar effect of the projector ray was noticed by an observer one night in September last. He was stationed at Quatre Barnes, a town intermediate between the two points holding communication, but screened from the direct rays of the lamp in the fort at Port Louis by a range of hills. It was a cloudless night, and when the ray was sent in his direction, it lit up the windows of his apartment. The illuminating ray could not, for reasons already given, have been direct, and it is consequently surmised that its path was deflected in some peculiar manner through the atmosphere through which it passed.

"Professor Trowbridge has a new storage battery in the Jefferson Laboratory about which the public knows very little, but which is one of the most remarkable pieces of apparatus in the laboratory," writes the Boston correspondent of the Western Electrician, November 7. "It contains 5,000 cells, which are like chemical test tubes, connected by strips of lead and filled with a sulphuric acid solution. They are arranged in tiers on shelves, and stand in movable colored blocks, four cells in each block. This is the largest storage battery in America. It is charged by a dynamo and will furnish 10,000 volts. With this new battery Professor Trowbridge intends to make advanced experiments with X rays during the winter, and the results of his work are likely to be of considerable interest to the scientific world."

The introduction into Buffalo of electric power from Niagara Falls directs attention to the economic as well as the scientific features of the enterprise. The Buffalo Express has been looking into this. It finds a large saving thus for producers and there is hope of much greater economy with improvements in the conservation of energy during transmission. At the outset the price charged per horse power, used for twenty-four hours in the day, is $36 a year. This is much less, the Express claims, than the cost of steam generation in places where it has been reduced to a minimum, and where the power is used only ten hours a day. With coal at $2 a ton, it is estimated, taking into consideration everything, including fixed charges, that the steam generation of 50 horse power, ten hours daily, costs $2,750 a year, or $55 per horse power. In a smaller plant the cost for each horse power developed would be much greater.

The unsuitability of electric traction for tramways with heavy gradients has been often urged. The following details, however, which are taken from the Glasgow Herald, give particulars of a line at Lausanne newly opened, and now working successfully, where the maximum gradient of 11·3 per cent. extends for 300 yards, probably the heaviest in Europe. Moreover, the line is hilly for its full length of 7¼ miles. The cars weigh empty six tons, carry 26 passengers, increasing the load to eight tons, and they have each two motors of 20 horse power, to give a speed of twelve miles an hour to seven miles on the heaviest gradient. The motors are of the four-pole type of 85 per cent. efficiency, and when developing 15 horse power run at 540 revolutions. Emergency brakes are fitted to the cars, consisting of a piece of iron with sharp teeth, which may be lowered down and forced against a wooden rack rail, by which means the car can be stopped within two yards on the 11·3 per cent. gradient. The overhead system is adopted, and the six-pole dynamos at the central station are driven by two Crossley gas engines, each of 130 effective horse power when working at 160 revolutions. They have flywheels of six tons weight. The current produced can be varied from 100 amperes at 125 volts to 140 amperes at 50 volts, and accumulators are provided at the station.

The fire danger lurking in electric flexible cord connections is practically demonstrated every now and then, and with it, too, the need of better cords, says an exchange. In a recent instance mentioned in a fire underwriter's report, a flexible cord, supporting a lamp, which was not burning at the time, suddenly developed says Cassier's Magazine, a short circuit and a one ampere fuse in a rosette opened, cutting off the current. The cord was quite greasy with oil coming from shafts and bearings, and dirty with lint which had accumulated. The risk was a cotton mill. The arc, though almost instantly cut off, was sufficient to set the cord on fire, and several inches of it was burned. The fire was quickly extinguished by an attendant, so practically no damage was done. A few days before this accident, an other cord developed a short circuit under practically the same conditions. In both cases the cords were hanging free in the air and had not been touched for a number of hours. It is the custom at this mill to frequently turn on and off the lamps by the key sockets, and also to frequently brush the lint off the cords. During the summer season the cords are wrapped together and tied in a bunch near the ceiling to get them out of the way. The best explanation of the trouble is that a strand of the fine wire broke and pushed its sharp end through the insulation, causing the short circuit. Both cords had one or two layers of cotton thread first, then a fairly thick outer covering of silk, but they were not rubber covered. These occurrences show that however quickly currents may be cut off by fuses, the heat generated by the arc is sufficient to set fire to the flexible cords, especially if they are at all greasy and covered with lint. A better cord may not mean one having a higher insulation, but rather one which could not be set on fire. It seems important that cord should be used which would prevent short circuits occurring under as great a number of conditions as possible, and at the same time prevent the flash produced by a short circuit from doing harm.

MISCELLANEOUS NOTES.

On the admission of Utah to the Union as a State last year, another star, the forty-fifth, was added to the national flag. It was placed to the right of the fourth row from the top. The order for the additional star was accompanied by one changing the size of the colors from six feet by five to five feet six inches by four feet four inches.

The Russian Island of Sachalin has a very curious climate. It is considerably warmer in the mountains, which rise to about 6,850 feet, than in the plains. In the coast regions the woods are composed of beeches, firs and other trees generally found in northern lands, while in the mountainous interior there grow bamboos, hortensias and other Japanese plants.—Prometheus.

The production of amber in Germany last year was about 440 tons, or nearly 100 tons more than in the previous year. By far the larger portion of the above quantity is put out by the two mines of Palmnicken and Kraxtepellen, belonging to the firm of Stantien & Becker, while the smaller portion is obtained by dredging and searching the shore of the Baltic Sea. The two mines named above, with the home industry, employ about 1,200 persons.

Artificial silk made according to Dr. Lehner's process is now used in the manufacture of tassels and other ornaments. Straw hat manufacturers in Switzerland also employ the new material, the silk being worked into narrow strips and then covered with insoluble gelatine, whereby it is given the appearance of straw, while exhibiting a much more brilliant luster. The strips are woven into braids and these are sewed together in the usual manner. Hats made in this fashion are much superior to ordinary straw hats, and when colored they even surpass silk hats in gloss.—Prometheus.

Mr. G. G. M. Hardingham writes to the London Times: As an illustration of the enlightened government prevailing in Turkey, as the result of "Palace" interference with the administration, it may be mentioned that patents for inventions which relate to the production of electrical energy, or in which electricity is in any way employed, are refused. There is nothing in the Turkish law to warrant any such refusal, and the only explanation afforded by the Turkish authorities is that orders have been received "from the Palace" forbidding the grant of patents for such inventions. It is perhaps superfluous to add that the fees paid on application are not returned.

The glassworkers of Carmaux have just had an object lesson in Socialism, says the Colliery Guardian. It appears that in consequence of a dispute between the employes and their masters a rival glassworks was started in Albi, a neighboring town, subsidized by Socialist capital, but principally as a response to Socialist appeals by benevolent persons who were under the impression that they were doing a great act of justice and carrying on a philanthropic work. The rival works appear to be supported, as they were commenced, by voluntary subscriptions. But the Carmaux workmen—to oblige whom the rival works were started—now bitterly complain and say that they are betrayed, for the new works will do them no good, but will supply a competitor for the trade by means of which they get their living.

During the last few months incandescent gas lighting has been the subject of much litigation in the law courts, but what has taken place in England, says the Chemical Trade Journal, is comparatively small as compared with the litigation in Germany, where the holders of the Welsbach patents are fighting the large number of competitors who have sprung up during the last year or so. A further step in the elucidation of the disputed patents has now been made, the "Nichtigkeitsableilung" of the German patent office having just given its decision in connection with the application of the Continental Gasglulicht Gesellschaft Meteor for the nullification of the Pintsch burner patent (No. 43,991) held by the German Incandescent Gas Light Company. The application was refused, the validity of the patent being upheld.

The Salt Lake Tribune publishes some timely facts as to the cost of producing an ounce of silver from the mines of Utah during the year ending June 10, 1896, as furnished in the returns of various diggings on file in the office of Assessor Lynch, as required by the law which imposes a tax upon the net output of the mine. These returns are accompanied by affidavits of their accuracy. Among this stack of returns is that which comes from the Old Jordan and Galena, namely, that in the production of 20,000 tons of ore a loss of over $13,000 was sustained, the superintendence of the property alone involving that amount of expenditure. The Phœnix Mining Company produced 632 tons of ore during the year, at an actual cost of $9,000, which also shows a loss to the producer. The Lexington, whose earnings have for years been going across the waters to fill the Parisians' pockets, notes another big loss during the year, although A. Lavignino approximates the net output at $15,000. The Maxfield mine produced 100 tons of ore, gross value $6,000, with $14,000 expended.

The Central Passenger Committee, representing the railways in the Central West, have at last decided, says the Iron Age, that a 5,000 mile interchangeable ticket may be issued. Restrictions are imposed which prevent the ticket from being in all respects what the business interests employing traveling salesmen have been demanding. Nevertheless, the action taken is a movement in the right direction, and changes are expected as the books get into general use. The ticket is to be participated in by all railways in the Central West which consider it their interest to do so. The books are to be photographic, and are to be sold for $100, through the office of the chairman of the association. None is to be good for passage on trains, the holder being obliged to exchange mileage strips at ticket windows for regular evidences of the right to travel. It is estimated that about fifty lines will co-operate, but some States will not be represented at present. Among these is Michigan, in which State it is believed that the railways will decline to enter into the arrangement, because it would place a powerful lever in the hands of those who are now working for a general two cents a mile law.

CANET'S DUPLEX MOUNTING FOR QUICK FIRING GUNS.

MR. G. CANET, of the Forges et Chantiers de la Mediterranée, of La Seyne, Havre, and Paris, has recently devised a new method of mounting guns in pairs for working on one platform; this system is illustrated by Figs. 1 to 4 on the present page. These illustrations represent two Canet quick firing 20 centimeter guns carried on a double mounting placed on a revolving platform. The mounting is composed of a twin sleeve, B, surrounding the rear part of the guns and carrying in front the trunnions that are supported by the side brackets of the frame. On the upper part of the sleeve (the sections, Figs. 3 and 4, show a modified arrangement) are the brake cylinders, and the compressed air reservoir by which the guns are brought back automatically; on the lower part of the sleeve is the locking slide of the elevating gear. The brakes are of the Canet system, with the central rod of variable section. The brake plunger has on each side a rod of different diameter. The smaller extends backward and is connected to the cross piece fixed to the breech of each gun; the larger, d, enters the cylinder during the period of recoil and drives out a part of the liquid it contains; this liquid acts through a pipe and valve, O, L, on the piston of the central cylinder, G, in which the air is compressed in front of the piston. At the end of the recoil the valve closes, but a second pipe open to both sides of the valve and controlled by a lever outside allows the liquid previously driven out to flow back into the brake cylinder under the influence of the air compressed in the receiver, thus throwing the gun forward into firing position. According to whether the by-pass pipe is opened or closed at the moment of firing, the guns are run out at once or are held back. The central variable rods are fixed to the projections on the upper part of the sleeve. They move during recoil inside the piston rods, thus constantly changing the area of the openings of the brake. The sighting devices are attached to the sleeve on the mounting. The guns are trained for elevation by a toothed sector fixed under the sleeve; into this gears a pinion worked through a countershaft by means of a hand controlling wheel and a pitched chain. The turning platform rests on a live ring of hard steel balls, and it can be trained either by hand or by an electric motor. The mechanism of this part of the mounting comprises a fixed toothed ring, two pinions gearing into it, and a third pinion on the shaft of which is mounted by means of a special compensating device a helicoidal gear. An endless screw drives this gear and is itself actuated either by a pair of bevel wheels connected with the electric motor or by a pitched chain transmission worked by hand. By means of a clutch the hand or power gear can be thrown at once into operation. A supply of ammunition is furnished to the gun by a central endless chain moving with the platform on the well known Canet system and delivering at the side of the mounting. Provision can be made for a store of projectiles being placed close to the platform, in which case only the cartridges would have to be delivered from below. This method of mounting, which is applicable to all calibers of quick firing guns, possesses the following very considerable advantages:

The weight and bulk of the mounting are reduced to a large extent, and consequently the weight and cost of the shield and local armor are also reduced. This reduction in weight means that the power of the ship for offensive purposes can be correspondingly increased. The axes of the two guns being as near as possible, the strain arising from firing one gun is reduced to a minimum; consequently, the wear of the mechanism from lateral training is also reduced. The men training the guns have all the necessary mechanism conveniently arranged, so that the guns can be fired more rapidly and with a reduced personnel. Both guns are elevated simultaneously; from this it follows that after a round has been fired successfully a second round can follow immediately, or, if any correction is necessary, it can be very rapidly executed. By this means the efficiency of the armament is increased. The arrangement has been developed from the twin mountings previously installed by M. Canet on the Prat, the Jauréguiberry, etc. But in these mountings the guns were trained independently, and were of necessity placed farther apart from each other. We are indebted to London Engineering for the cuts and copy.

THE FLEETS OF NATIONS.

A RETURN was published recently as a Parliamentary paper showing the fleets of Great Britain, France, Russia, Germany, Italy, and the United States of America, distinguishing battleships, cruisers, coast defense vessels, torpedo vessels, torpedo destroyers and torpedo boats, built or building. The return also shows date of launch, displacement and armament reduced to one common scale. Vessels which appeared on June 2, 1896, in the official list of each navy as built or building are enumerated, including under the latter head those for which on that date money had been appropriated and which were shortly to be laid down. Great Britain has 45 battleships, 18 armored cruisers, 87 protected cruisers, 16 unprotected cruisers, 15 coast defense vessels, 3 special vessels, 35 torpedo vessels, 42 torpedo boat destroyers, and 3 first class torpedo boats, all built; and 12 battleships, 29 protected cruisers, and 48 torpedo boat destroyers building. France has 29 battleships, 9 armored cruisers, 23 protected cruisers, 20 unprotected cruisers, 14 coast defense vessels (armored), 1 special vessel, 13 torpedo vessels, and 4 torpedo boats, all built; and 6 battleships, 1 armored cruiser, 14 protected cruisers, 3 torpedo vessels, and 2 torpedo boats building. Russia has 10 battleships, 9 armored cruisers, 3 unprotected cruisers, 13 armored coast defense vessels, 4 special vessels, 16 torpedo vessels, 2 torpedo boat destroyers, and 3 torpedo boats, all built; and 8 battleships, 2 armored cruisers, 3 protected cruisers, 4 armored coast defense vessels, 1 special vessel, 1 torpedo vessel and 1 torpedo boat building. Germany has 21 battleships, 7 protected cruisers, 22 unprotected cruisers, 11 coast defense vessels, 1 special vessel, 5 torpedo vessels, and 4 torpedo boats, all built; and 3 battleships, 1 armored cruiser, 6 protected cruisers, and 3 torpedo boats building. Italy has 13 battleships, 1 armored cruiser, 15 protected cruisers, 1 unprotected cruiser, 2 special vessels, 15 torpedo vessels, and 3 torpedo boats, all built; and 2 battleships, 5 armored cruisers, 1 protected cruiser, 3 torpedo vessels, 1 torpedo boat destroyer, and 1 torpedo boat building. The United States has 5 battleships, 2 armored cruisers, 18 protected cruisers, 10 unprotected cruisers, 19 armored coast defense vessels, 2 torpedo vessels, and 2 torpedo boats, all built; and 4 battleships and 2 torpedo boats building.

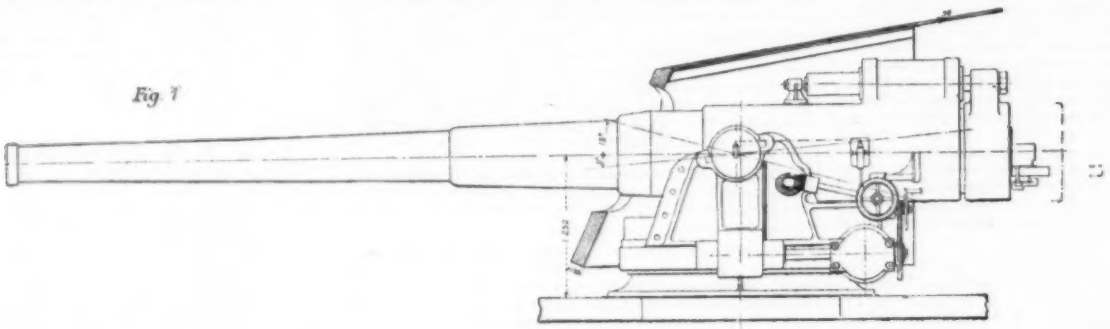
EVOLUTION OF THE STOVE.

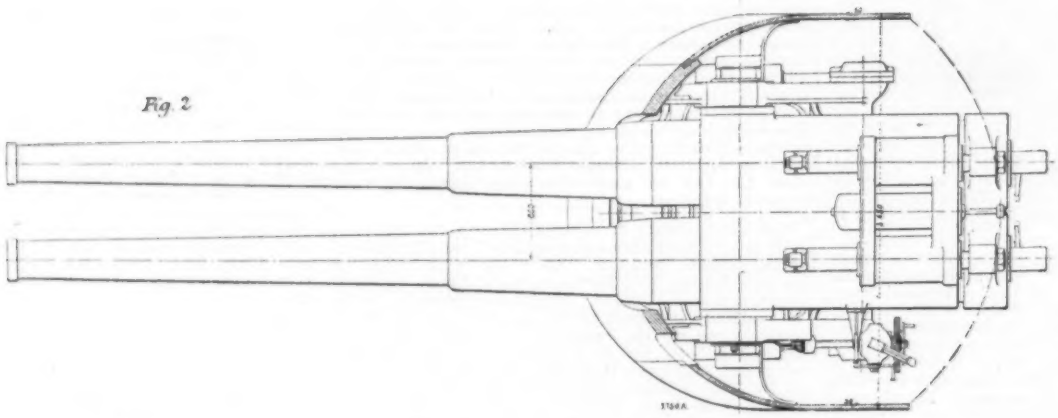
IN a recent news item the finding of the historic Beecher stove at Litchfield, Conn., is briefly described. This is the first and only article relating to stoves, apart from articles in strictly technical journals, that the writer has ever seen. The reader will search in vain through current literature as contained in magazines for any article devoted to or in any manner illustrating the invention and progress of stove making. Search will be equally barren of results if made in museums for an early stove, or for a stove with which is connected a tale of historic history.

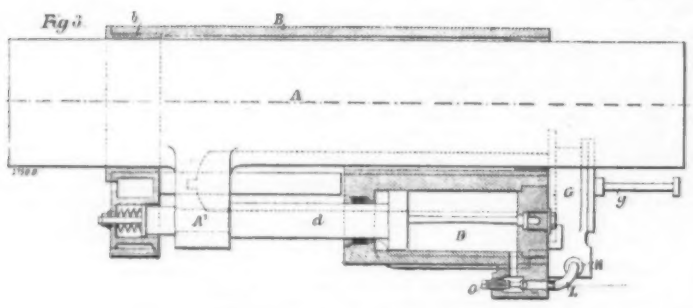
Before the advent of the first stove, pot hooks, cranes, and hangers, as they were called, were found in the kitchen of the prince and peasant. Meat was roasted on a spit or in a pot covered with hot ashes. Baking was done in a pan over the embers or standing at an angle in the corner of the fireplace. Stewing or boiling was done in pots suspended from a crane which, being secured to the side of the fireplace, as a farm gate is hung, swung either in, over the fire, or out and away from the fire, as occasion demanded. How a dinner of many courses, with such crude appliances, could be brought along together without the burning of the viands earliest done and the undercooking of the last to be served, would somewhat puzzle a modern cook.

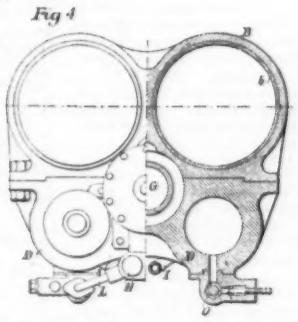
There were but two methods of heating. All of the larger rooms in a house were furnished with fireplaces. For heating smaller rooms, or a guest's chamber, recourse was had to either a pan of hot ashes or a brazier, which was an article made of sheet iron or of earthenware, very much resembling a tinman's fire pot. A fire was built in the brazier with charwood. After the gas had thoroughly burnt off, it was ready for a very limited use.

Benjamin Franklin invented a grate which in some form is used even down to the present time. It was a very simple affair. The writer had the pleasure of examining a well preserved original a few years ago. The grate proper, which gave name to the contrivance, was of the same general form as the modern fireplace grate. It was supported on either side by two pieces of iron standing upright. Underneath was a metal hearth, which projected well out into the room, and was intended to catch the ashes or a stray coal that might fall. A bar at the top connected and held together the two uprights, as the hearth connected them at the bottom, thus giving firmness to the structure. From









CANET'S DUPLEX MOUNTING FOR QUICK FIRING GUNS.

the crosspiece at the top a curved piece of iron depended in the rear, which gave direction to the draught and also served as a reflector to the heat. This device was masoned up in the fireplace, leaving an opening in the flue of the chimney directly in the rear of the grate. The separate attachment, known as the blower, and which is a part of any modern grate, an essential for rapid fire building, was not invented until long after. The fire on the hearth, while pleasing and cheerful, gave to the room about 4 per cent. of the heat evolved from the combustion of the wood. The Franklin grate did a little better, as it was claimed at the time that 10 per cent. of the heat was saved by its use.

Difficulties of draught were obviated in course of time by the invention and use of a flue, which through the chimney in the rear of the grate connected with the outside air, thus supplying the fire from an independent source and preventing the dangerous back draught. After a little time an improved form of the Franklin grate was made, which stood out in the room, connected by a short piece of pipe with the chimney.

First in Verona and soon afterward in Munich had been invented a very rude substitute for the modern cooking stove. This was about the year 1780. With the exception of the grate bars, the material was brick. Imagine, if you please, a structure of masonry 10 ft. square and 3 ft. high with cone-shaped depressions of various sizes reaching well down into the structure, with a grate at the bottom of each, and an opening to enable the attendant to rake the fire or remove the ashes. Each cone was connected by a concealed flue, with one common chimney, which provided an exit for smoke and gas. The holes were covered by immense stopples made of clay, resembling in shape exaggerated champagne corks. These were used in the place of iron plates.

Benjamin Thompson, Count Rumford, did more than any person previously, and it might be safely said, also, that he did more than any man that came after him, to improve cooking, heating, and ventilation. He experimented with the masonry stove, adding flues and dampers. His first great departure was an oven for roasting meat. This resembled a section of the so-called boiler to a modern water back range. This oven was incased in masonry, with a grate underneath, and a flue connecting with the chimney. He had a shelf in the oven upon which a pan rested; the front was closed with a hinged door.

Rumford's next invention was the immediate precursor of the modern cooking stove. It was a square structure of cast iron resting on four legs. It had no oven; it was simply an iron box with a grate across its entire bottom. The plate on top was pierced with a number of openings.

During the Jackson campaign it occurred to some genius that the plain sides of this boxlike stove afforded an excellent opportunity to place the semblance of "Old Hickory's" face in an enduring material. So the Jackson stove came to the front, with Jackson's face larger than life on the door, the American flag on one side and Jackson fighting behind cotton bales on the other. This form of stove continued as a vehicle for the advertisement of presidential candidates to the time of Polk.

A variation on the box stove consisted of a stove built of boxes of diminishing size piled up one upon another, until in some instances a height of ten feet had been reached. This was certainly an advantage so far as radiation was concerned. A highly ornamental variety of this stove can be seen in the basement of the State house at Richmond, Virginia.

Eliphalet Nott, who was a native of Connecticut, born in 1773, did more than any comparatively modern person to advance stove making, not only in a practical way, but also in artistic design. His parlor stoves were first made during the classic period in affairs, about the time infant cities in the West were being named after places in the Roman empire, and also after the sages and heroes of antiquity. His stoves, therefore, resembled Grecian and Roman temples, and, to elaborate this idea, room was required far beyond any present conception of stove making. Stoves resembling the Parthenon perched upon the Acropolis, suited for heating a hall or church, required a height of about twenty feet. They were huge fabrics of cast and sheet iron. Sometimes these were surmounted by classic figures, made of the shiny Russian iron.

Dr. Nott, if not the inventor, was certainly the improver of a class of cooking stoves well illustrated by the type known as the "Dutchess County Farmer," soon afterward followed by the "Dutchess County Farmer Improved." This was a very large stove, an excellent baker, and about the first to contain a reservoir for hot water and a raised oven. The "Dutchess County Farmer," like a well conducted bank, honored all of its acceptances with generous pans of well baked bread, pies the crusts of which were of flaky crispness, while cakes and puddings came to the table from it, as an enthusiastic housewife once told the writer, "as if baked on a sunbeam."

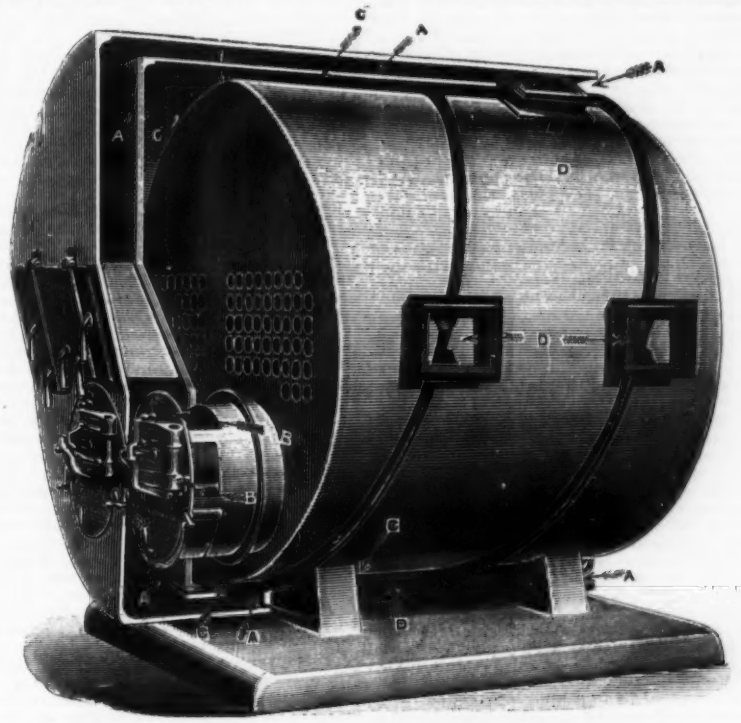
The next important era in stove making was marked by the invention of an under flue, which rendered baking in a stove oven a positive success. The base burner, with a self-feeding reservoir, was fully as important an invention in the stove intended strictly for heating.

The inventor has not been idle in recent years so far as the making of new styles of stoves is concerned. There have been and now are stoves of marvelous construction. Some years ago a cooking stove was exhibited that was expected by its inventor to revolutionize all previous attempts in that line. This stove was circular in form, and its top consisted of one plate of iron perforated with holes of varying size. This plate was not fastened to the sides of the stove, after the usual manner, but rested on a pivot which allowed it to revolve. Fastened to the underside of the plate was a gear wheel which matched in another wheel of smaller size turned by a crank. Without removal, pots, kettles, and pans could be brought to the front or retired by a turn of the crank.

Stoves in some form have been in use about one hundred years, yet perfection has not been reached, except perhaps in form. The most imaginative dreamer cannot forecast the twentieth century stove. The very best constructed modern stove, whether for cooking or heating, is wasteful of fuel to a degree that is beyond comprehension, when the economy of modern processes in other directions is remembered. The amount of coal needed to cook a meal for an average family would not exceed a pound in weight if the heat from its combustion could be treasured and used economically. A field is here open for an invention that will bring with it a reward exceeding in money value any invention of the nineteenth century.—A. H. C., in the Evening Post.

EAVES' HELICAL INDUCED DRAUGHT.

MESSRS. SIR J. BROWN & COMPANY, Sheffield, are now introducing a further improvement on the Eaves induced draught Serve tube system, with which they have been so long identified. By reference to the accompanying illustration the new system will be easily understood. The cold air for the combustion of the fuel enters from the back end of the boiler, passing along the outer space, A and A', to the valves, B and B', in the furnace fronts; on its way this cold air is guided round the outside of the inner space, C, in a helical



MARINE BOILER FITTED WITH EAVES' HELICAL DRAUGHT.

direction by partitions set up as shown. After combustion the waste hot gases leaving the boiler pass through the smoke box into the inner space, C, and are made by similar partitions to pass round and in close contact with the boiler in a helical direction on their way to the suction fan. The boiler by these means is thoroughly enveloped in the escaping heat, effectually preventing either radiation, condensation or straining of the boiler under any forced conditions, such as rapid generation of steam from cold water, or sudden and greatly increased evaporation. The cold air on its way to the valves also absorbs a large amount of heat from the escaping gases, and so enters the furnaces at a greatly increased temperature, with resultant economy. No blocking up of the bottom boiler tubes through any deposit in the smoke box can, it is claimed, take place, as such deposit, if any, drops to the bottom of inner casing, C, from whence it is easily removed by doors at front. The doors, D, are placed so as to allow of a brush being passed through, to sweep away any sooty deposit from the boiler shell, should any such deposit take place. The makers inform us that very careful experiments have been made with this system, with results varying from 78 to 82 per cent. of efficiency, and a coal consumption of from 30 to 35 lb. per sq. ft. of grate. The trials gave a boiler efficiency in one case of 82 per cent. and in the other 78 per cent. of the actual calorific value of the coal used. If we take the mean of these figures, namely, 80 per cent., and work out the evaporation on the basis of best Welsh coal, we obtain the following results: Heat units from complete combustion of 1 lb. of best Welsh coal, 15,629; latent heat of evaporation from and at 212° Fah., 966; calorific value of coal in pounds of water evaporated per pound of coal from and at 212° Fah. $= \frac{15{,}629}{966} = 16{\cdot}18$ lb.; 80 per cent. of the above calorific value $= \frac{16{\cdot}18 \times 80}{100} = 12{\cdot}95$ lb., or practically an evaporation of 13 lb. of water per lb. of coal from and at 212° Fah., with a rate of combustion of over 30 lb. of coal per sq. ft. of grate and with a ratio of heating surface to grate surface of only 28 to 1. An ordinary marine boiler of the same dimensions as the one used in these trials, namely, 10 ft. 6 in. diameter, 10 ft. 6 in. long, will, with good natural draught, evaporate about 5,000 lb. of water per hour, the efficiency being about 65 per cent., or equal to 10·5 lb. of water evaporated per lb. of best Welsh coal from and at 212° Fah., instead of 13 lb. The trial boiler has now been at work nine months, and on examining the shell it was found to be free from any sooty deposit, in excellent condition, and no signs of corrosion or leakage visible. We are indebted to London Engineer for the cut and particulars.

THE FIRST HORSELESS HACK IN PARIS.

THE first horseless hack is finally running in Paris, and we take pleasure in presenting the aspect of it to our readers.

The length of the vehicle, between extreme perpendiculars, is about ten feet, while an ordinary hack with its horse occupies more than fifteen. If, as is to be hoped, the application of automobile hacks becomes general, the obstruction of the streets will be less than

THE FIRST HORSELESS HACK AT PARIS.

it is with hacks drawn by horses, even in leaving out of consideration the influence exerted upon such reduction of obstruction by the increase of the mean speed of vehicles. The wheels of the hack under consideration are of wood, and are provided with solid rubber tires. The interior is very comfortable, the length of the vehicle being sufficient to permit the passengers to stretch their legs, and to allow it to easily hold three persons, the third person sitting upon a small bracket seat on the outside. The vehicle is run by a single cylinder gasoline motor arranged in the box forming the back of the carriage. This motor, which is of the four period type, receives a mixture of air and gasoline coming from a carbureter. The ignition of the mixture is electric. The gas from the cylinder, after doing its work, escapes into a receiver, and thence into the atmosphere, under the hack. The supply of gasoline is fifteen quarts. The cooling of the motive cylinder is assured by twelve and a half gallons of water contained in two reservoirs arranged laterally in the box. The steam, due to the heating of the cylinder, circulates in a tubular chamber placed horizontally upon the motor casing. The motion of the vehicle automatically produces a rapid circulation of air in the interior of the tubular chamber, and this facilitates the cooling and condensation of the steam produced by the heating of the cylinder. The power of the motor is transmitted to the driving wheels in the rear by a system of pulleys and belts that actuate an intermediate shaft, which in turn actuates the axle of the wheels through a pitch chain. This combination permits of rapidly suppressing the action of the motor upon the wheels without stopping it. The low speed varies between six and seven miles per hour and the high between thirteen and fifteen. The intermediate speeds are obtained by varying the richness of the gaseous mixture and the proportions of its admission to the cylinder, the effect of this being to reduce the power of the motor and consequently the speed of the vehicle.

The slipping of the belts contributes toward rendering the speed regular and reducing the reactions due to the frequent and often inverse variations of the power of the motor on the one hand and the resistance of the roadway on the other. The motion is transmitted to the hind wheels through a differential movement, and the fore wheels, which serve for steering, are controlled by a hand wheel with horizontal axis placed in the center of the carriage. The driver sits upon the seat to the left, so that he can steer with his right hand. With this same hand he actuates the brake and changes the speed. Against the seat and between his legs, he has at hand the device for regulating the mixture of air and gasoline, as well as the admission of the same to the cylinder. A pedal brake under the right foot, acting upon the axis of the driving wheels, and a hand brake, acting upon the tires of the hind wheels, permit of a quick stoppage of the vehicle. A tool box is suspended against the dashboard, which forms a wind break and no longer a mud guard. The total weight of the carriage in running order is about 1,980 pounds.

Such are the principal arrangements of the first horseless hack running in Paris through the happy initiative of Mr. Biguet, who, through the financial aid of Mr. Dalisson, had this vehicle built. A second automobile hack will soon be run in the city by Mr. Doulat. An automobile hack company is in course of formation at Bordeaux, and next spring fifty vehicles of the Société Anonyme Francaise de Fiacres Automobiles will be running in Paris.

We are witnessing the beginning of an evolution whose importance cannot be foreseen. Paris will always remain the classical paradise, but it will cease to be the purgatory of horses. We can only applaud this humanitarian progress, and wish every success to the first horseless hack.—La Nature.

EARTHQUAKES, THE PULSE, NERVE WAVES, AND TELEPATHY.

By VAUGHAN CORNISH, M.Sc., in Knowledge.

THE earth trembles with the shock of displacements which occur from time to time in those superficial parts which are termed the earth's crust. These displacements are the bending, crumpling, cracking, or slipping of the rocks, and, occasionally, volcanic outbursts or upheavals. The most general description of the original disturbance is a wrench: that is to say, a single movement which may be analyzed into two components, a pull and a twist, or a shear. Most earthquakes originate at a depth which is rather great compared with the depths of mines, but very small compared with the diameter of the earth. The vibration which they produce at the surface is generally that corresponding to a wrench. The movement which goes on between the origin and the surface is probably, as in other cases of transmission by waves, different from the disturbances where the wave is set up, and where it ends. A wrench both compresses and distorts the rock, and two waves appear to be set up—a wave of compression and a wave of distortion—which travel with different velocities. The elasticity of volume of the rock—the force with which it tends to recover elastically from compression—enables the solid earth to transmit a wave of longitudinal displacement, which is similar in character to the sound-producing waves which are elastically transmitted in fluids. The rigidity of rock, the force with which it elastically recovers its shape after distortion, enables the solid earth to transmit a wave of transverse displacement, which may be compared to the light-producing waves transmitted by the ether. When these two waves break simultaneously at the earth's surface, the shock (as has been said) may resemble the complex disturbance which originated the waves; but if one wave travel quicker than the other, the character of the surface disturbance at its commencement may be simpler. In practice it is found that when the origin of the earthquake is at a great distance the preliminary tremors precede the main shock by a considerable interval, which indicates that some part of the disturbance travels more quickly than the rest.

The interval which elapses between a shock at the surface near the origin and its arrival at a point near the antipodes is often so short that, according to Prof. Milne, the wave cannot have had time to travel round the earth by transmission through the superficial layers of rock, having regard to the rate at which these are known to transmit wave motion. It appears, therefore, that the seismic wave can be transmitted right through the earth. Delicate seismographs show an almost continual trembling and quivering of the

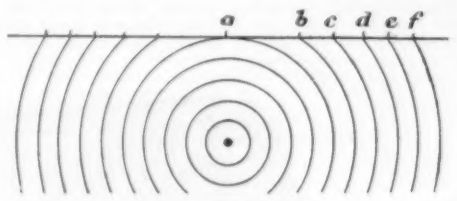


FIG. 1.

earth's surface, the tremors at any point being generally due to local causes, but occasionally caused by distant shocks. The surface of the earth, being the boundary of the transmitting medium, experiences a maximum amount of disturbance. The familiar experiment with a row of glass marbles illustrates this point. If a shock be given at one end of the row, it is the marble at the opposite end of the row which moves most, the intermediate marbles transmitting the shock, but moving scarcely at all. At the boundary of the transmitting medium a wave breaks, and the energy takes on a new and violent form. Thus is the shore battered by the sea, and thus is the earth heated by the breaking of the ether waves sent to us by the sun.

The "speed of an earthquake," like the speed of electricity, is a term which may have several different meanings. The most important speed from a practical point of view is the quickness with which the shock reaches successive points throughout a country exposed to the visitation. This is a variable velocity which depends not only upon the speed of the earthquake wave, but also upon the position of the origin. If the wave radiates in circles from the origin, and if the circles in Fig. 1 represent the wave front at successive minutes, then the positions a, b, c, d, etc., are the points on the earth's surface where the shock is felt at the successive minutes. It is seen at a glance that the apparent surface speed of the earthquake is much greater nearly above the origin, and that at a distance it tends to reach a constant value which is nearly that of the true rate of the wave. If, however, as is probable, the increase of pressure so much increases the elasticity of rock that the speed of the wave is greater at greater depths, the wave front will not be spherical, and the "rays" drawn from the origin at right angles to the wave front will not be straight lines, but will be curved toward the surface, as Dr. A. Schmidt has pointed out.* The effect upon the surface speed is shown in Fig. 2; it first diminishes rather rapidly until it reaches

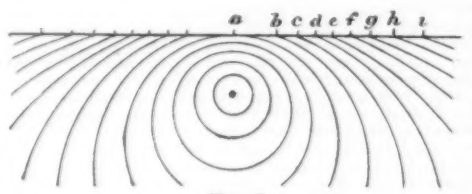


FIG. 2.

a velocity equal to that of the wave at the origin, but afterward increases gradually. The progressive visitation of the localities, a, b, c, d, etc., as shown in these figures, is not the travel of a surface wave but the arrival of an obliquely moving breaker. The disturbance of level which is produced by the breaking earth waves does, however, set up a true surface wave, the ground undulating much as the surface of water will undulate if a submarine mine be exploded. The surface earth wave is said to be a gravitation wave: that is to say, one which travels by the attraction which subsists between the disturbed parts and the remainder of the globe. The amplitude of the surface earth wave is very small. Seismic sea waves, on the contrary, are often of terrific height. In these the surface wave is often due more to ruptural displacement of the sea bottom than to mere oscillatory movement. The great sea waves which traversed the southern oceans during the convulsions at Krakatoa were presumably due to such displacement.

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The pulse is produced by a peculiar wave which demands a brief mention in this article. To fix our ideas we will suppose that we are dealing with the familiar artery which gives the pulse of the wrist. At each beat of the heart, blood is pumped into the near end of the artery and the valve is quickly shut.

* See Nature, October 24, 1895.

Very quickly afterward an extra quantity of blood is forced from the artery into the veins and capillaries. This is not the particular dose of fluid which has just entered the artery, but a discharge from the other end of the stream, where a pulse is felt almost immediately after the throb of the heart. The push, or impulse, is transmitted from point to point along the artery, not as hydrostatic pressure is transmitted by an incompressible fluid, but after the manner of a wave. For the blood is not inclosed in a rigid pipe, but in a flexible tube, so that, although the fluid does not yield to pressure, the tube does, and the end nearest the heart expands to accommodate the extra dose of fluid. Expansion of the tube is, however, followed by contraction, for the tube is elastic, though yielding. The next portion of the tube then expands, and so on, a billow traveling down the artery. When the billow reaches the wrist it can be both seen and felt. It has passed the wrist before the next dose of fluid is delivered from the heart, so that only one billow is ever traversing the artery. The profile of the billow is recorded in an exaggerated manner upon the well known pulse tracings. These provide a permanent record of the condition of a patient's pulse which is convenient for reference. Each of the pulse tracings shown in Figs. 3 and 4 records a number of beats; the wave is traveling to the right; from trough to trough is a complete pulsation.

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The brain is kept in touch with the external world by some kind of wave motion, the mechanism by which the sensory nerves transmit their message. The velocity of the wave, which is always considerable, varies to some extent in different people, as one would naturally expect. Responding to the wave of feeling, transmitted by the sensory nerves, is the wave of will, whereby the motor nerves transmit to the muscles the message of the brain.

Whether mind can act upon mind, otherwise than by means of the ordinary senses, is a much debated question. Some aspects of this question of telepathy come within the proper scope of physical science. It comes within the province of physical science, for instance, to inquire into the possible extra-sensual means of action of one brain upon another. Space is filled with a medium, known to science, which has a wonderful power of transmitting very various disturbances without loss and with great swiftness, and one would naturally inquire first whether the known modes of motion of ether are such as might account for telepathic phenomena, on the supposition that the active brain is capable of disturbing the ether. Now one of the most remarkable points about the narratives of, say, phantasms of the dying, is that the intensity of the recorded impressions scarcely diminishes with distance, even though the distances vary from one mile to eight thousand miles. Waves radiating from the brain will therefore not explain the recorded phenomena, for even if the motion be transmitted without loss, the expansion of the wave front would rapidly diminish the intensity. Nothing else than a motion or disturbance confined to a channel will do, as happens, for instance, in the disturbance and reproduction of disturbance between the sending and receiving parts of a telephone. These are connected by the telephonic wire. I am not aware that anything has been found corresponding to a telepathetic wire.

THE THERAPEUTICS OF EXERCISE.

By A. G. CLOPTON, M.D.

NO one appreciates the great good to humanity resulting from the achievements of the nineteenth century more than I do—but its benefits are so general, so full, and have come so silently, that we must analyze to appreciate them. The question may be asked: Are these grand achievements of which we boast an unmixed good; have they not been made at much sacrifice which might have been avoided? Is physical culture worthless, that it should be neglected as now? Can we boast of a superiority over the people of the former century in everything? Are we their equals in those attributes which go to make the perfect man, and upon which health and happiness, individually and collectively, depend? We live in a luxury of which our forefathers never dreamed. But do we sleep as soundly? Do our bodies thrill with the glow of health as did theirs? Are we as quick of eye, as firm of tread, as ready of judgment? While cultivating the intellectual forces, are we not planting the seeds of decay?

Our ancestors, in the primitive days, had large, expanding lungs, full chests, strong and hard muscles, exhaustless strength, and knew but little of the aches and pains and ills which are now so general that we accept them as natural to human life. The higher type of savage was perfect in form, lithe in movement, keen of vision, and strong of arm; he knew nothing of the higher culture: he was an animal, it is true, but a noble one. Now I would ask: In the pursuit of science and wealth and luxury, are we not neglecting our bodies; and is this necessary? Man is an animal—an intellectual animal, it is true, but the full development of his body is necessary not only to his health, but to his complete mental development. Why the increasing number of the insane, filling our asylums, private and public? Why so many sudden deaths from so-called heart trouble? Why the prevalence so general, as compared with the first half of the present century, of Bright's disease? And, above all, why the increasing statistics of death from consumption? I believe all these are due mainly to neglect of physical culture.

Progress is so rapid, the daily business of life so exacting, competition so great, that we have no time to attend to our bodies. Given two men of the same mental gifts and general attributes—that is to say, assidu-

FIG. 3.—PULSE TRACING OF DISEASED HEART.

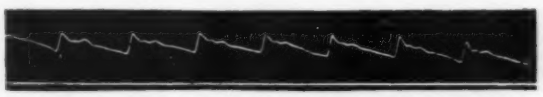

FIG. 4.—PULSE TRACING OF FAIRLY NORMAL HEART.

ity, perseverance, ambition, love for one's life work—the one strong and healthy, the other feeble and weak; the one sleeping and eating well, the other doing both badly and failing to assimilate his food; the one a stranger to aches and pains, the other tormented with neuralgia and constipation; and both engaged in the same mental work. Now, if both die at the same age, the work of the former will outstrip in scope and value that of the latter.

Everything intertwines and interlaces every other thing, and everything, to a certain extent, depends upon every other thing. This law applies more especially to the development of the human being, who, to be complete, must develop along all the lines. Montaigne has well observed, in speaking of man:

"I would have the disposition of his limbs formed at the same time with his mind. It is not a soul, it is not a body, we are training, but a man, and we must not divide him."

Physical culture includes exercise. Food and air being sufficient, there is no other way of developing any part of our organism. Exercise means youth, functional vigor, and a high standard of organic life. Muscle will only grow and develop by being exercised; if not used, it wastes and atrophies. It is by the exercise of the skeletal muscles that we can, under the will indirectly, exercise the muscles of the heart and of respiration, of the arteries, and of all movable parts related especially to the nutrition of the body. The body consists of individual cells, and so long as the vitality of these is maintained at normal standard there can be no disease. I am one of those who believe it possible to resist all diseases, in a measure, by close observance of the laws of hygiene. Preventive medicine is forcing itself upon the attention of the physician and the people, and one cannot prophesy the miracles it will perform; but the purpose of this paper is to discuss only one feature of hygiene.

The bodies are neglected, to cultivate the brain, and the result is that cell activity is lowered and the economy is the prey of every disease that comes along, infectious or otherwise; a current of air often prostrates with catarrh or pneumonia or, perhaps, consumption. There is no power of resistance, therefore no immunity. Herbert Spencer years ago said that "the enlightened people of this age take an interest in the raising of the offspring of all creatures except themselves."

The law of reaction obtains to everything, and it is probable that this law will produce a change in the life of future generations; already evidence of this is seen. Physical culture, more especially exercise of the skeletal muscles, now engages the attention of educated men and women, and no doubt will in time bring forth good fruit. I quote from another the declaration that it was not until 1875 that the English Channel was crossed by a swimmer; not until 1877 that a man had ever leaped, without artificial aid, to the height of six feet two inches from the ground; further there are men who can now jump across a gap twenty-three feet in width; a mile has been run in a few minutes. I do not cite these facts as evidence that scientific exercise must result in accomplishing such feats, to be complete, but to show that interest is awakened in the question of exercise, and that it is receiving an attention not heretofore given it. These extraordinary feats have done this much good: they cause thinking people to realize what may be accomplished in developing the human body by systematic training.

The purpose of exercise is not to make giants of pygmies, or to make a Samson of a Tom Thumb. There are factors, hereditary and otherwise, that limit the effects of exercise. Exercise, rationally applied, develops the body along all lines into symmetrical proportions. Physical culture is most effective if begun in early childhood. This is the time in human life when the human being is not responsible, but the parents and family physician are. It is then that the body is the most impressible, as well as the mind; it is then that the bent twig may be straightened. The results in the development of the body by systematic exercise begun in childhood with stunted children of stunted parents, as given us through statistics, are wonderful.

By reference to Mr. Charles Roberts' Manual of Anthropometry, we learn that:

"Growth is most rapid during the first five years of life.

"From birth to the age of five years, growth is the same in both sexes.

"From five to ten years, boys grow more rapidly than girls; from ten to fifteen years, girls grow more rapidly than boys, and from eleven to fourteen are actually taller, and from twelve to fifteen are actually heavier, than boys.

"From fifteen to twenty years, boys again take the lead and grow at first rapidly, then gradually slower, and complete their growth at about twenty-three years of age.

"After fifteen, girls grow very slowly, and attain their full stature at twenty years of age.

"The statistics show a very slow but steady increase of stature up to fifty years, and a rapid increase in weight up to sixty years. Some children appear to grow by fits and starts. Children remaining several years below the medium height may suddenly shoot up and attain more than the normal stature when they reach adult age."

These statistics are valuable as a guide as to the best time in the life of the individual to apply systematic exercise, and further teach that the time for the most satisfactory results differs in the two sexes. It is during the period of the most rapid growth in stature that most can be done in correcting the deformities of childhood, whether hereditary or acquired. If systematic exercise of definite parts is postponed until adult life, the results are not so marked, though much may be done.

The scientific regulation of exercise, especially during youth, does more than to increase the size and height of the body; body symmetry generally is the result, giving grace and litheness to the movements. Muscular co-ordination is made more perfect. Of all animals the human being is most subject to variations in proportions and symmetry. To-day if one were to take the measurements of all the individuals in any one assembly, I doubt whether one would be found of perfect symmetry—that is, with the two corresponding halves exactly agreeing. This want of symmetry (not amounting to a deformity) a systematic course of training, especially during the period of growth, would correct. The long, lanky, graceless lad, whose height has outrun his muscle, may be made to become a well proportioned, graceful man. He needs the systematic exercise of every muscle daily; therefore his trainer, whether physician or parent, must understand how this is to be done. The short, stumpy lad, with big head and chest, with legs out of proportion to his trunk, ungainly and unsightly, may be developed into a well-proportioned man—yes, may be made to represent the highest type of physical manhood. Here the legs need exercise more than the muscles of the trunk, and for such cases bicycle exercise should be prescribed early in life.

The power of exercise, rightly applied, to develop deficient parts without increased development of normal parts, is remarkable. McLaren cites the case of a lad, nineteen years of age, whose height was not increased by exercise, but who increased the girth of his chest four and a half inches in nine months. A more remarkable case is reported by the same author, which not only proves that special parts may be exclusively developed, but that such development may be brought about long after the natural period of growth has passed. A man thirty-five years of age, at the end of two months' exercise at the Oxford Gymnasium, had increased the circumference of his chest no less than four and a half inches.

Exercise of the skeletal muscles tends to expand the lungs and sends to the organs and tissues fresh arterial blood more frequently; body metabolism is increased and cell activity strengthened; the heart beat is increased within normal limits, and the system is cleared of waste matters; the sewers of the body act more efficiently. Lagrange, in his work on Body Exercise, observes:

"Heat causes in muscle fibers the first stage of contraction, or at least an aptitude for coming into action under the will more quickly. The maximum aptitude for contraction in human muscle is at about 40° C. It is then that a man's muscle can act more quickly and he can make use of all his force."

This author compares the preliminary sparring before a fight, the preliminary canter before a race, and the movements of an angry animal before an attack, to the heating up of a locomotive before it starts upon its run. Here we have a practical lesson. In exercising, or prescribing exercise, the greatest effort must not be made at the start. The muscle should be gradually warmed up to its work. A neglect of this precaution will result in the immediate fatigue of the muscle and an abandoning of the prescription. Again, we should understand that as the muscle becomes accustomed to work, its capacity for work increases, and it may be increased daily until it reaches its extreme limit before fatigue.

Skeletal muscle exercise is perhaps the only remedy for obesity. When a man suffering from obesity applies to the physician, he is put upon a special diet, all food being prohibited which it is thought will be transformed into fat during the process of assimilation; this does no good, but will surely do harm. Such prescription, prohibiting nourishing food, if it does anything, deprives the cells of their needed nourishment, weakening their vitality without reducing the obesity. Muscular exercise is the remedy in these cases, and it should be directed and enforced by the physician. These people abhor exercise, and must be driven to it with the lash.

Fat is a reserve tissue fuel for the body combustion. It is easily disassimilated, and as it is uncombined with the tissues structurally (only deposited), its removal within limits does no harm. As the obese man loses fat under this regular and systematic exercise, his muscles become firmer and harder and larger, and contract more easily under the will; he soon becomes hardened, is not easily fatigued; his chest expands more, the heart beat is less sluggish, and the intellect brighter. To quote Lagrange again:

"Exercise produces in the system two absolutely different effects: it increases the power of assimilation, by which the body gains new tissue, and accelerates the process of disassimilation, by which certain materials in excess are destroyed."

Exercise is necessary to thin people who assimilate too little and fat people who do not disassimilate enough. Again, general exercise promotes regular evacuations of the bowels, and how important this is to health I need not explain.

The longer I live and investigate matters relating to medicine, the less confidence I have in the materia medica, and the more in preventive therapeutics. Expand the lungs by exercise in the open air, draw in draughts of fresh air, make the blood course more rapidly through the tissues, clear out the waste matters as soon as formed, drink a plenty of pure water without whisky, bathe regularly, and you may defy disease.

But it must be remembered there can be too much of a good thing. Exercise ought to be willingly performed and should stop short of muscle fatigue, and must be kept up, in a measure, through life. Exercise last year gives no immunity this year, only in so far as it has developed the organism. When muscle is fatigued it responds to the will with difficulty, and exercise then is of no benefit.

If exercise has the effects I claim, it must have a good effect upon the mind and morals of man. It improves, of course, the circulation of the blood in the brain, and aids all cerebral acts; it stimulates thought. A proper distribution of mental and physical work is the great desideratum. When we do this, our system of living is as perfect as we can make it.

"Prescribe fencing, gymnastics with apparatus, lessons in riding school, to all those idle persons whose brains are languishing for want of work. The effort of will and the work of co-ordination which these exercises demand will give salutary stimulus to the torpid brain cell.

"But for a child overworked at school, for a person whose nerve centers are congested by persistent and close mental application, prescribe long walks, the easily learned exercises of running, and failing of better, the old game of leap frog, prisoner's base, running games—anything rather than difficult exercises or acrobatic gymnastics."—Lagrange.

With such persons the mind must entirely relax while the body plays. The same prescription will not apply to all; that for the working man and that for the hard student must differ. Exercise in the various sports which are now becoming popular will give individual character. It is a good way to cultivate in the boy the qualities which adorn the man, as it gives pluck, courage, endurance. It teaches him to be quick of hand and eye and prompt of judgment. It is a good school for discipline, self-control, self-reliance. The games which are becoming popular in our schools and colleges will in time extend among the people as national games, and, if kept within bounds and regulated, will make the future citizens of this republic brainy and muscular, independent and self-reliant, lovers of freedom and ready to battle for it.

A word as to the dangers of too much exercise, of excessive exertions and straining. These I can only enumerate:

First—Breathlessness.—In the beginning of exercise it is very easy to pump one's self out of wind. Avoid this by beginning mildly and gradually.

Second—Muscular Fatigue.—If you apply an electric current to an exercised muscle, it will contract, but if you apply it too long or too strong, the muscle quickly refuses to respond to the strongest stimulus; it must recover its contractility. The same condition may be produced in the living body by too long or too active contractions of muscle under exercise. Too active exercise, even when muscle fatigue is not produced, will be followed by stiffness, at least until muscles have been hardened and taught endurance.

Third—General Fatigue.—Overwork is followed by a depression which is often followed by general disturbance and fever, the "fever of over-exertion" continuing for days, due, no doubt, to the throwing into the system of waste matter more than can be eliminated, which thus acts as a poison.

The effects of excessive exercise may be any of the following: Heart rupture, hypertrophy of heart, dilatation of its cavities, or valvular disease, rupture of blood vessels, aneurism, varicose veins, hernia, hemoptysis, rupture of muscles, fracture of bones.

Thus no prescription requires more judgment and accurate knowledge on the part of the prescriber than exercise of the skeletal muscles. The physician who has no general knowledge of anatomy and physiology is incapable of prescribing the manner and amount of exercise. He must know the relation of each muscle and group of muscles to the bones, and the relation of special organs to special parts, and the functional dependence of each upon each, and, above all, the relations between voluntary muscular and cerebral action, before he is competent to give rational and scientific directions about body exercise. There is an organic pathology and a psychical pathology. Every case of paraplegia or hemiplegia is not due to organic lesion; perhaps oftener such a condition is caused by psychical lesions, so to speak—an abeyance of will power. We must know something about the latter pathology before we can assume to teach the dumb to speak or the lame to walk.—The Medical Age.

THE EYESIGHT OF CHILDREN.

So many independent factors are at work in human affairs that it is peculiarly difficult to associate any two phenomena relating to man, as cause and effect. It is a matter of common observation that the wearing of spectacles by those under middle age is on the increase, and, especially in Germany, where the change is most striking, the attempt has been made to attribute modern defective vision to the increased strain placed upon the eyes by modern elementary education. It would be a matter of the gravest concern were it proved that universal education, which we have regarded as a great engine of civilization, was actually destroying the keenness of the most important sense organ. The suggestion of this possibility makes it urgent that there should be made a most careful scrutiny of the actual facts, and, in particular, that it be found out whether or no defects in school accommodation or increased stress of school work is contributing to a possible degeneration of civilized races. The lighting arrangements of schools and the tasks made necessary by examinations are conditions that could be altered without much difficulty, if it were found that they exert an unfavorable influence. Mr. Brudenell Carter—a distinguished London surgeon, who has devoted himself specially to the study of vision—has recently presented a most valuable report to the education department. "My lords," recognizing the importance of the results obtained already, are making arrangements for the carrying out of a prolonged series of investigations throughout the country on the lines laid down by their expert.

Mr. Brudenell Carter made arrangements with the authorities of twenty-five elementary schools in London, with the result that 8,125 children were subjected to simple tests of vision. Of these it turned out that just under forty per cent. were possessed of normal vision in both eyes. Between two and three thousand of the children with defective vision were subjected to careful medical examination by Mr. Carter or by a skilled colleague, Mr. Belcher Hickman. The eye consists of a combination of refracting agencies, the lens, cornea, and so forth, which focus the visible rays of light upon the retina, a nervous sensitive screen at the back of the eye—corresponding to the sensitive plate upon which the photographer obtains his negative. In normal vision, rays coming from a distant object are focused exactly upon the retina, while for near objects the eye exerts its power of accommodation by which the refractive strength of the lens is increased. The common optical defects, all of which result in impaired vision in a lesser or greater degree, are of three kinds. In cases of myopia, or short sight, either the eyeball is too long or the refractive combination is too strong, with the result that the image falls, not on the retina, but some little distance in front of it. In cases of hypermetropia the eyeball is too short, or the refractive combination too weak, with the result that the image is formed behind the retina. In cases of astigmatism the surface of the cornea is not truly spherical, the curve of two axes at right angles to each other being different.

Myopia or short sight is in the first place of a congenital character, one of the structural variations which are common in all animals and plants. In uncivilized communities those born with a degree of myopia sufficient to be a disadvantage no doubt are rapidly weeded out in each generation. The ease by which it may be corrected by spectacles, and the modern cheapness of

accurately curved glasses, almost completely remove the disadvantage of the condition, and we must be prepared to find the cessation of natural elimination of those with moderate short sight, accompanied with a resulting gradual increase of numbers. On the other hand, myopia, if its possessors are subjected to trying conditions, tends to become progressive, and progressive short sight is a very serious matter. Mr. Brudenell Carter's report will set the minds of anxious school managers at rest. He has found no evidence of any extended prevalence of this condition. The proportion of cases was small, and it bore no relation whatever to the lighting of the school, the two schools in which the greatest proportion of cases occurred being respectively the best and worst lighted of the whole number. Still more important was the complete absence of any evidence as to progressive myopia. Some of the worst cases occurred among children who had recently joined school, and there was nothing to show that it increased with the length of time the children had been at school. To examine further into this unexpected and agreeable conclusion, Mr. Carter has arranged to examine a number of selected cases next year.

In the matter of astigmatism there was no evidence of school life being detrimental. The proportion of cases was less than the proportion discovered in Mr. Carter's private practice among patients examined for every kind of optical weakness. The vast majority of optical defects were due to hypermetropia. This condition differs from the others, in that it is not so much due to natural variations in the structure of the eye as to arrested development. A hypermetropic eye is a small, badly developed eye, and is frequently to be found associated with general feebleness of the bodily frame. It is only natural that it should be found abundantly among the children of the poorer classes, for most children naturally have a slight hypermetropia, which is gradually corrected in the more fortunate cases as healthy growth proceeds. Where children are badly fed, the optical defect may be, and often is, increased with age. But this increase has no connection with school life, and can be counteracted only by improvements in the general condition of the poorer classes.

The most unexpected result of Mr. Carter's investigations was that a very large proportion of the cases of defective vision were due, not to structural defects in the refractive combinations of the eye, but to imperfect practice in seeing. It occurred to him to compare the vision of children at a country school with his town cases, and he found that country vision was very much better. The country child has an expanse of landscape before him presenting numerous objects under visual angles rendered small by distance. His eyes are exercised beneficially by the perpetual variety of objects that attract him at all distances and his standard of vision is increased beyond the normal. As might be expected, this improved vision is more noticeable in country boys than in country girls, as these lead a less active life.

On the other hand, the vision of town children is limited by their environment. They see the other side of the street in which they live, and the carts and traffic of the thoroughfare. Their visual attention is seldom attracted to any object at a distance, and, from lack of the physiological stimulus to growth given by increased use of an organ, their eyes remain in an imperfect condition. Mr. Carter urges strongly that the vision, especially of town children, should be tested and trained systematically. He urges that it should be included among the physical faculties which are tested by competition and for proficiency in which prizes are given. Such competitions would tend forcibly to diffuse a knowledge of what a normal vision should be. Those who were acutely subnormal would find out their defects in time to have them remedied, while the great majority of town children, whose defect of vision is an accidental result of their environment, would be stimulated to improve their organs by the necessary practice.—Saturday Review.

LANGUAGES TAUGHT BY PHONOGRAPH.

MANY novel projects have been devised in the way of language teaching, but never until just lately has the phonograph been made part of the outfit of the linguistic professor, says the New York Herald. It is difficult at first to see how this instrument can help along teaching of any kind, but thereon hangs the tale.

The man who has adapted the phonograph to this profession is R. D. Cortina, and he has been so successful that already he has sent out over five hundred machines, all loaded with his instruction and primed with his voice.

Until the phonograph was applied to languages it was necessary for any one wishing to study a foreign tongue to sit literally at the feet of the master and learn the pronunciation and the accent from his very lips.

Books might be pored over and a language partially learned in that way, but the voice of the teacher had to be heard. The idea came several years ago to Mr. Cortina that through the phonograph he could practically duplicate himself in every corner of the civilized world.

His method is simple. With each phonograph there is sent his text book, twenty loaded cylinders and twenty blank ones. Each lesson in the book is arranged in the form of questions and answers. The pupil, ready to begin, puts the cylinder of the first lesson in the machine, the tubes in his ears, and starts the phonograph. Keeping his eye on the book he hears the words and phrases repeated, with their proper accent, just as if the professor stood at his side. There is an additional advantage that the lesson can be repeated twenty or a hundred times if necessary, until every sound is familiar to the pupil. Then, having thoroughly learned these sentences, he puts one of the unused cylinders in the machine and repeats the lesson. In a little paper box the cylinder goes back to New York, and at his earliest opportunity Mr. Cortina inserts it into his own machine. At his side is the stenographer. As he listens to the lesson repeated back, now stopping the phonograph, now starting it going again, he dictates his criticism, where the pronunciation is wrong, what is right, what the mistakes are and where they have been made. The letter and the cylinder go back to the pupil, who reads and listens to his own voice reproduced. Then, taking up the original cylinder once more, he is able to tell just where the difference lies.

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